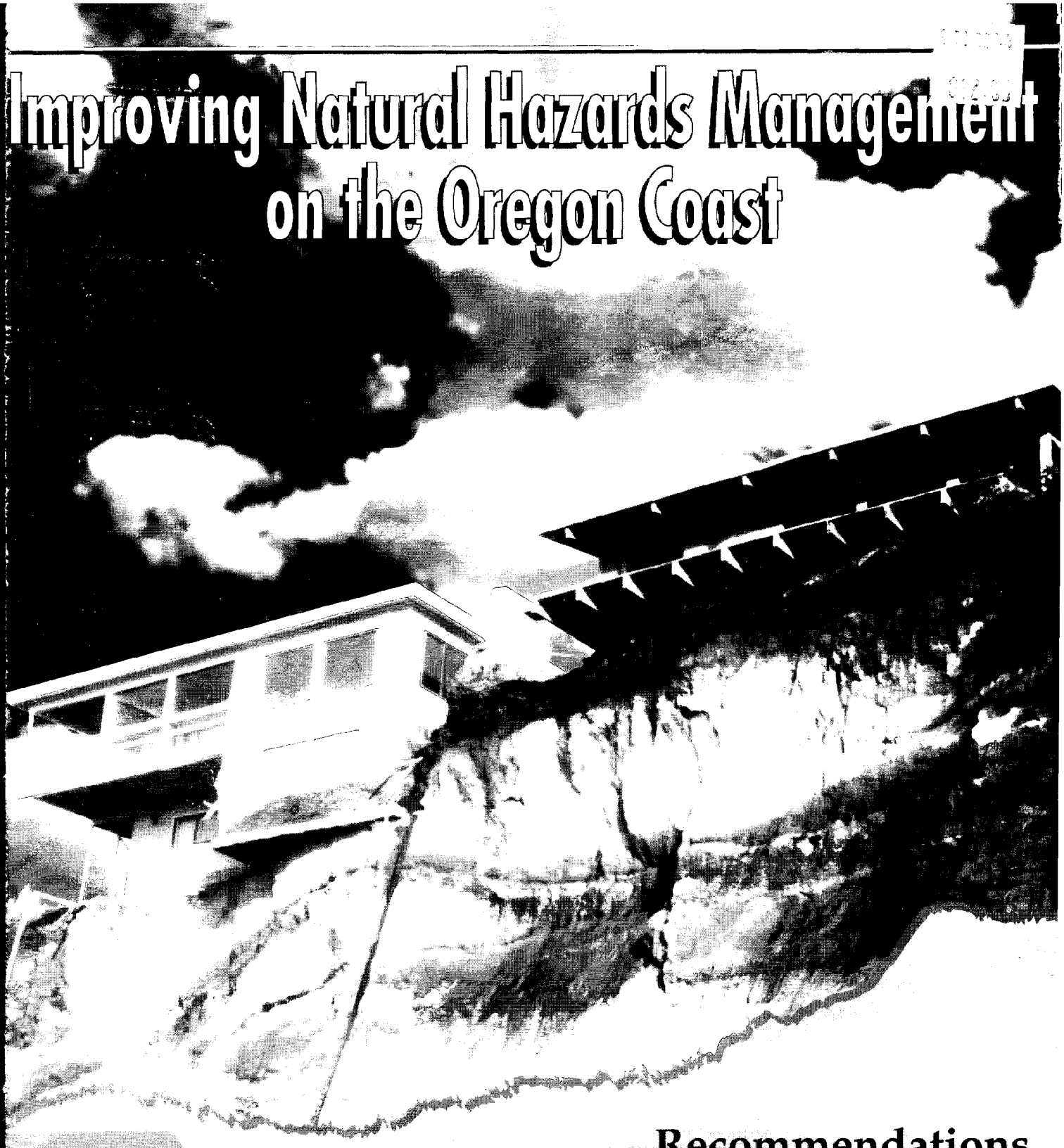
Improving Natural Hazards Management on the Oregon Coast



Recommendations of the Coastal Natural Hazards Policy Working Group 1994

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Oregon Sea Grant
Oregon State University
Corvallis, Oregon

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Preface and Acknowledgements

This report is the culmination of more than two years of work by a dedicated group of 20 coastal residents and resource managers that made up Oregon's Coastal Natural Hazards Policy Working Group (see Appendix A). To produce this report, these individuals participated in 19 one- or two-day workshops between March 1992 and May 1994. The group identified natural hazard problems and possible solutions, took their ideas to the public in a series of workshops, sought and considered public opinion, and formulated the recommendations in this report. Along the way, they benefitted from the advice of many specialists and citizens who made presentations or offered opinions on hazard issues and options.

The Policy Working Group arrived at the recommendations in this report through a process of consensus building. Consequently, the group's recommendations do not necessarily represent what any one member might have recommended independently. Although some differences of opinion remain, the members of the group agreed that they can "live with" the negotiated recommendations presented here.

A special word of thanks is due to Ms. Ann Snyder, a professional facilitator and trainer from McMinnville, Oregon. Ann helped organize and conduct more than a dozen of the policy group's two-day workshops. Her outstanding facilitation, conflict resolution, and consensus-building skills and her good humor and chocolate contributed a great deal to the successful completion of the project. Much learning also took place as those skills were passed on. Ann, on behalf of the entire group, thank you.

Also deserving special mention are the three graduate research assistants from Oregon State University who ably assisted with all aspects of this project: Andrea Ansevin, Paul Salop, and Cal Sawyer.

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—James W. Good
Project Coordinator

Executive Summary

Executive Summary

In March 1992, Oregon's Coastal Natural Hazards Policy Working Group was formed. Composed of 20 individuals representing a broad range of public and private interests on the coast, the group began a two-year project to identify coastal hazard issues, examine how these issues were being addressed today, formulate alternative solutions, and recommend improved policies and practices, based on public input and their own analysis. The process the group used to accomplish this is outlined in the full report.

This summary outlines the issues and recommendations presented in the full report. It is designed to give the reader an overview. However, as with any summary, many details are missing and, as they say, the devil is in the details. For specifics on issues of interest, the reader is urged to refer to the appropriate section of the full report.

Twenty-three issues are outlined here along with 79 recommendations. In italics, following each of the recommendations, the principal implementing agencies, organizations, or institutions are listed. More detail on the issues, recommendations, and implementing actions, as well as on the findings of the policy group can be found in the full report. The issues are organized in four categories: hazard identification, beach and shore protection, land use, and disaster preparedness and response. The pages on which each issue appears in the full report are noted below.

Issues and Recommendations

Hazard Assessment and Information Access

Issue 1—Existing maps and information about coastal natural hazards are inadequate for planning and decision making (page 29).

Recommendation 1-1. Establish criteria and standards for collecting, reporting, and mapping information about chronic and catastrophic coastal natural hazards. Give special attention to classifying hazard areas, particularly to the definition of "high-hazard areas" referred to elsewhere in these policy recommendations *(Department of Geology and Mineral Industries [DOGAMI]).*

Recommendation 1-2. Inventory and catalog coastal natural hazards studies, maps, digital data (for example, bathymetry and topography), and other information available from city, county, state, federal, university, private, and other sources *(DOGAMI, Oregon State University [OSU] Hatfield Marine Science Center [HMSC]).*

Recommendation 1-3. Develop standardized coastal hazard maps for priority areas along the Oregon coast at a scale of 1:4,800 (1" = 400') or larger. Maps should include both chronic and catastrophic hazards information. Public funds should not be used for site-specific coastal hazards investigations unless the public benefits outweigh the costs *(DOGAMI).*

Recommendation 1-4. Fund basic and applied research on chronic coastal natural hazards following specified priorities *(DOGAMI and other institutions).*

Recommendation 1-5. Fund basic and applied research on earthquake and tsunami hazards and hazards mitigation following specified priorities *(DOGAMI and other institutions).*

Issue 2—Geotechnical site reports are inadequate for making decisions on land development and shore protection projects (page 33).

Recommendation 2-1. Establish improved procedures for geotechnical site reports for coastal land development and shore protection projects. Specific needs include content standards for geotechnical site reports, a list of "triggering mechanisms" that will initiate the process, public disclosure requirements, a 10-year sunset clause, and local and state peer review processes *(DOGAMI).*

Recommendation 2-2. Improve the licensing process for geologists, engineering geologists, and engineers who work in the coastal zone, requiring certification and continuing education on uniquely coastal topics *(Oregon Board of*

Geologists and Engineering Geologists Examiners & Board of Engineering Examiners, DOGAMI).

Issue 3—Information about coastal natural hazards is not readily available, nor is it well understood by users and effectively applied in decision making (page 37).

Recommendation 3-1. Establish a coastal hazards information system and repository with an easily accessible database and a special collection of materials *(OSU Hatfield Marine Science Center).*

Recommendation 3-2. Develop and implement educational programs about coastal natural hazards to increase the knowledge, skills, and effective application of hazards information to decisions *(OSU Extension Sea Grant).*

Issue 4—Hazard disclosure during property transactions is insufficient (page 40).

Recommendation 4-1. Revise the real estate disclosure form in Oregon Revised Statutes (ORS) 696 to require that all known or potential natural hazards affecting a property be disclosed by all sellers (the owner or the owner's agent) to all potential buyers before a property transaction is finalized *(State Legislature, Oregon Seismic Safety Policy Advisory Commission [OSSPAC]).*

Recommendation 4-2. Establish and maintain a database that includes all known information on natural hazards affecting real property, and make this database available to the public so that it can be determined if a property is located in a hazardous area *(OSU HMSC).*

Recommendation 4-3. Prepare and make available to prospective buyers of potentially hazardous coastal property a "buyer's guide" or hazards evaluation checklist. In the guide, include information on how to access additional information or contacts *(OSU Extension Sea Grant).*

Beach and Shore Protection Procedures

Issue 5—Goals and policies for shore protection are inconsistent and outdated, particularly with regard to hard structures (page 44).

Recommendation 5-1. Establish clear, consistent goals and policies for operating the beach and shore protection program administered by the Oregon Parks and Recreation Department (OPRD) under the Beach Law *(State Legislature, OPRD).*

Recommendation 5-2. Strongly discourage hard shore protection structures (SPSs) that fix the shoreline in place and interfere with the physical processes of the natural beach and shoreland *(State Legislature, OPRD).*

Recommendation 5-3. Conduct a thorough review of studies of alternative shore protection techniques throughout the U.S. and the world. Test and evaluate promising alternatives to revetments, seawalls, and other hard shore protection structures; some alternatives are dune construction, vegetative stabilization, beach nourishment, and dynamic revetments *(U.S. Army Corps of Engineers [USACOE], OPRD, DOGAMI).*

Issue 6—There are gaps and overlaps in shore protection regulatory jurisdiction and in the interagency review and decision-making process (page 49).

Recommendation 6-1. Regulate the installation of all ocean shore protection structures, other activities designed to stabilize or protect the beach or oceanfront property, and other construction on or immediately adjacent to the beach, including repairs of existing structures. Precise jurisdiction should be determined jointly, in advance, by OPRD, Department of Land Conservation and Development (DLCD), DOGAMI, and the affected local government *(State Legislature, OPRD).*

Recommendation 6-2. Place exclusively under OPRD's control both regulatory permits and the decision-making authority for ocean shore protection structures and activities. Minimize administrative costs by establishing an OPRD-coordinated permit review and evaluation process based on the legal authority and expertise of relevant state and local agencies *(State Legislature, OPRD).*

Issue 7—The shore protection permit process is poorly structured, has weak review standards and limited enforcement authority, and the appeals process is antiquated (page 54).

Recommendation 7-1. Establish a coordinated process for shore protection decision making, including an evaluation of hazards and threats to property, alternative mitigation techniques and designs, impacts of alternatives, and compensation needs *(State Legislature, OPRD, DOGAMI, DLCD, and local* governments).

Recommendation 7-2. Vest sufficient administrative and civil enforcement authority in OPRD to ensure an effective beachfront and ocean shore regulatory program. Change the appeals process so that any person aggrieved by an OPRD permit decision under ORS 390.650 can petition the OPRD director for reconsideration of the final decision *(State Legislature, OPRD).*

Issue 8—Emergency shore protection policies and procedures are lacking (page 57).

Recommendation 8-1. Establish clear, consistent definitions, policies, procedures, and conditions for allowing "emergency" shore protection. Specify what constitutes an "emergency," who makes decisions, what measures are permissible (excluding revetments and seawalls), and standard requirements, including the requirement for removal *(State Legislature, OPRD).*

Land Use Planning, Governmental Coordination, and Fiscal Responsibility

Issue 9—Land use planning and site-specific land use decisions, as they relate to coastal hazards, suffer from ineffective integration of existing and new hazards information, piecemeal decision making, and poor communication and coordination among administrators of land use, shore protection, beach management, and hazards research programs (page 61).

Recommendation 9-1. Adapt the special area management planning (SAMP) process to oceanfront beaches and shorelands along the Oregon coast. Undertake a pilot SAMP for a high-priority oceanfront area, and identify other priority coastal areas for application of the refined SAMP process *(Land Conservation and Development Commission [LCDC], DLCD, OPRD, cities and counties).*

Recommendation 9-2. Establish a local land use notification process for oceanfront development projects that could lead to future OPRD-regulated shore protection proposals *(LCDC, State Legislature).*

Issue 10—Development in hazardous areas is often subsidized by public funding (page 65).

Recommendation 10-1. Eliminate tax write-offs for capital losses due to natural hazards for new structures or major additions to existing structures in designated high-hazard areas *(State Legislature).*

Recommendation 10-2. Establish development surcharges for building permits and land use actions in high-hazard areas consistent with the actual costs of development *(cities and counties).*

Recommendation 10-3. Establish a process for evaluating coastal natural hazards in government development, grant, and loan procedures *(Economic Development Department and other relevant agencies).*

Recommendation 10-4. Prohibit direct public development, grants, loans, or loan guarantees for essential facilities, hazardous facilities, major structures, and special occupancy structures in high-hazard areas. Exceptions would be for situations where such hazards are fully mitigated by structural or nonstructural means or when the facility cannot be feasibly located outside high-hazard areas (for example, port facilities, marinas, other water-dependent facilities, water and waste treatment facilities, and similar uses). Public subsidies of other types of development in high-hazard areas should generally be discouraged *(Economic Development Department and other relevant agencies).*

Recommendation 10-5. Expand the federal flood insurance program to an all-hazards program, covering at least erosion, earthquakes, and tsunamis for residences, businesses, and public buildings; couple all-hazards insurance with stringent mitigation requirements designed to minimize disaster

losses *(U.S. Congress, Federal Emergency Management Agency [FEMA]).*

Issue 11—There is no consistent way to determine what properties along the Oregon coast are "unbuildable" due to natural hazards (page 67).

Recommendation 11-1. Establish and apply a classification system and criteria for determining development capacity of oceanfront lots with respect to hazards *(LCDC, DLCD).*

Recommendation 11-2. Amend the Oregon Tax Code to provide owners of hazard-prone property with an enhanced tax credit for donating property to a public entity or a private, nonprofit land trust for permanent, nondevelopment-related public use *(State Legislature).*

Recommendation 11-3. Establish a public fund to purchase fee simple or development rights to property that is deemed unbuildable based on the criteria in Recommendation 11-1 *(OPRD).*

Issue 12—Past land use decisions and existing uses unduly influence decisions on new development (page 69).

Recommendation 12-1. Establish a sunset clause for new subdivisions that limits the time allowed for development to occur and provides for the automatic vacation of the subdivision at the time of sunset; review previously approved subdivisions as required by ORS 92.205-92.245 (Undeveloped Subdivisions), modifying or vacating as appropriate; simplify plat vacation and reconfiguration procedures to expedite the process *(local government, DLCD, LCDC, State Legislature).*

Recommendation 12-2. When a public or private infrastructure extension is proposed to service new development, evaluate the extension for its potential to influence land development in hazardous areas. When an evaluation suggests increased hazard risks or impacts, require that the infrastructure extension be modified to eliminate or minimize such adverse impacts *(LCDC, DLCD, local governments).*

Recommendation 12-3. Evaluate existing public infrastructure in areas not yet built up for its influence on land development in hazardous areas. Where reasonable, abandon, relocate, or otherwise restrict development to minimize threats to life or property *(LCDC, DLCD, local governments).*

Issue 13—Oceanfront construction setbacks, as now implemented, have not proven to be an effective means for avoiding hazards (page 71).

Recommendation 13-1. Develop, test, and refine a coastwide technical methodology for coastal construction setbacks, whereby each property would be evaluated on its unique characteristics using the most up-to-date information available *(LCDC, DLCD, DOGAMI, OPRD, local government).*

Recommendation 13-2. Using the coastal construction setback method in Recommendation 13-1, require that setbacks be determined by a qualified professional for all shoreline development subject to coastal natural hazards *(LCDC, DLCD).*

Recommendation 13-3. Allow variances to required coastal construction setbacks only when (a) building design and proposed construction techniques minimize exposure to natural hazards, (b) no concurrent or future hard shore protection structures are permitted, or (c) maximum setback variances on other parts of the property have been already been granted and incorporated into the design *(LCDC, DLCD).*

Recommendation 13-4. Do not allow the use of lot coverage or building density allowances as the basis for a variance to required coastal construction setbacks *(LCDC, DLCD).*

Issue 14—Development continues to be sited in earthquake and tsunami high-hazard areas (page 74).

Recommendation 14-1. Establish a system of special zones, procedures, restrictions, and conditions to limit development in earthquake and tsunami high-hazard areas *(LCDC, DLCD, DOGAMI, local governments).*

Recommendation 14-2. Prohibit the construction of or significant additions to essential facilities, hazardous facilities, major structures, and special occupancy structures in earthquake and tsunami high-hazard areas *(LCDC, DLCD, DOGAMI, local governments).*

Recommendation 14-3. Limit other types of development in high-hazard areas to low-intensity uses. In addition, establish specific conditions and building standards for development that will prevent collapse of structures when they are subjected to expected earthquake or tsunami forces *(LCDC, DLCD, DOGAMI, local governments).*

Recommendation 14-4. Develop long-range plans to phase out existing essential facilities, hazardous facilities, major structures, and special occupancy structures located in earthquake or tsunami high-hazard areas. Similarly, phase out or relocate utilities and other infrastructure in these high-hazard areas when normal replacement or major overhaul is due *(local governments).*

Recommendation 14-5. Incorporate information on tsunami run-up associated with forecasted Cascadia subduction zone (CSZ) earthquakes into the national flood insurance program and rate maps as data becomes available *(FEMA, DOGAMI).*

Earthquake and Tsunami Disaster Preparedness and Response

Issue 15—Because they are vulnerable to earthquakes or tsunamis, many structures and facilities, including recently constructed ones, are potentially unsafe (page 79).

Recommendation 15-1. Identify and inspect structures and facilities in coastal communities that are vulnerable to earthquake or tsunami hazards. At a minimum, make a visual inspection, examine the underlying soil, and estimate the survivability of the structure in the event of a major earthquake or tsunami. Communicate the inspection results to local governments and the owners and operators of private structures and facilities *(DOGAMI, Building Code Division [BCD], local building officials, private sector).*

Recommendation 15-2. Establish procedures for retrofitting, upgrading, or relocating structures and facilities identified as unsafe during inspections conducted in accordance with Recommendation 15-1 *(BCD, DOGAMI, local building officials, private sector).*

Recommendation 15-3. Conduct a study of seismic hazard zones 3 and 4 building code requirements with respect to the sustained ground shaking, liquefaction, tsunami inundation, and other hazards expected during a large CSZ earthquake. Upgrade coastal Oregon building codes to conform to the results of this study with special requirements as needed *(BCD, DOGAMI, local building officials).*

Issue 16—There is limited public awareness of what earthquake and tsunami hazards are, what risks are involved, and how to plan for or respond to such events (page 82).

Recommendation 16-1. Assign state leadership responsibility for earthquake and tsunami awareness, risk reduction, and preparedness and response education to DOGAMI, in partnership with the Oregon Emergency Management Division (OEM). These agencies should integrate their efforts and make full use of other centers of scientific and technical expertise, financial support, and educational services *(State Legislature, DOGAMI, OEM).*

Recommendation 16-2. Assign local leadership responsibility for earthquake and tsunami awareness, risk reduction, and disaster response and preparedness education to county emergency management authorities. Base such education on a likely earthquake scenario for each area, recognizing the critical role of local chapters of the American Red Cross, fire and police departments, medical providers, the Coast Guard, Extension, and other agencies, organizations, and auxiliaries *(State Legislature, local emergency managers).*

Recommendation 16-3. Design and implement broad-based, sustainable educational programs focused on increasing awareness of earthquake and tsunami hazards and improving disaster preparedness and response. Target audiences are coastal residents and visitors, schools and youth, service providers, businesses and industry, developers and contractors, and financial and legal sectors *(DOGAMI, OEM, local emergency managers, and education organizations and institutions).*

Recommendation 16-4. Establish and participate in an earthquake education network in the Cascadia region (Oregon, Washington, northern California, and British Columbia) to coordinate education activities, and share resources, materials, and know-how. Compose the network of educators, public and private

educational institutions and organizations, and other interested individuals *(DOGAMI, OEM, local governments, others).*

Recommendation 16-5. Identify, collect, catalog, and store existing earthquake education materials at a statewide or regional clearinghouse. Disseminate this information to educators and others in the Cascadia region *(lead agencies and the Cascadia Earthquake-Tsunami Education Network).*

Recommendation 16-6. Identify outstanding educational materials and approaches from other areas. Tailor the material to specific audiences, learning styles, educational levels, and geographic areas of Cascadia *(lead agencies and the Cascadia Earthquake-Tsunami Education Network).*

Issue 17—State and local emergency management plans do not adequately address the scope and scale of coastal earthquake and tsunami hazards and risks (page 86).

Recommendation 17-1. Require preparation of an earthquake annex to Oregon's all-hazards Emergency Operations Plan, based in part on what was learned in Quakex-94. At the state level, emphasize emergency relief hierarchy and procedures; reestablishment of basic services and lifelines, including power, communications, water and sewer services; and emergency repair of roads and bridges *(State Legislature, OEM, FEMA, others).*

Recommendation 17-2. Develop a model earthquake annex for coastal county emergency plans based on a detailed earthquake or tsunami scenario developed by DOGAMI and provide technical assistance to counties and cities in adapting the model to their area *(State Legislature, OEM, local governments and emergency managers).*

Recommendation 17-3. Following the OEM model earthquake annex (to be developed as per Recommendation 17-2), counties, cities, and other organizations, as determined by counties, should develop earthquake annexes for their all-hazard emergency plans *(local governments and emergency managers).*

Recommendation 17-4. Require that state and local earthquake annexes to emergency plans be peer reviewed periodically by a team appointed by OEM; this is to ensure that the annexes are kept up-to-date with the ever-expanding knowledge base on coastal earthquake hazards and mitigation strategies *(State Legislature, OEM).*

Issue 18—Earthquake preparedness and response planning for businesses, families, schools, and individuals are inadequate (page 88).

Recommendation 18-1. Evaluate existing levels of disaster preparedness in homes, schools, and work places. Develop a strategy for making structural and nonstructural inspections and improvements and for distributing FEMA and Red Cross guides and brochures that explain how to prepare disaster response plans and supply kits, eliminate home hazards, and respond to an earthquake *(local emergency managers, DOGAMI, OEM, others).*

Recommendation 18-2. Use grassroots organizations such as community volunteer programs, neighborhood associations, and community planning organizations to contact and assist families and individuals *(local emergency managers, local organizations).*

Recommendation 18-3. Require school officials to develop and implement earthquake preparedness plans consistent with FEMA Bulletin 88 (*Guidebook for Development of a School Earthquake Safety Program*) and additional guidelines for tsunami evacuation, if applicable *(State Legislature, OSSPAC, DOGAMI, OEM, Department of Education).*

Recommendation 18-4. Require that commercial or industrial businesses or public agencies that use or store hazardous materials on-site develop earthquake preparedness and response plans. Strongly encourage other businesses, particularly those with a large number of employees or customers or those located in hazardous locations, to prepare such plans *(local governments).*

Recommendation 18-5. Develop emergency preparedness and response plans at Oregon coastal ports and other marine and waterfront businesses. These plans should emphasize tsunami hazards and evacuation *(OEM, port officials, local emergency managers, Sea Grant programs).*

Issue 19—The organizational structure for coastal emergency management is not fully implemented (page 91).

Recommendation 19-1. In the event of a regional disaster, automatically place under the command of county emergency management authorities all cities, special districts, and other emergency service providers who do not have an emergency plan or who do not specify incident command relationships *(OEM, local emergency managers).*

Recommendation 19-2. Organize all local emergency responders using a command system that follows one of several available models. In the system selected, clearly define hierarchical relationships between counties, cities, special districts, essential service providers, private relief organizations, OEM, and FEMA *(OEM, local emergency managers).*

Issue 20—Local disaster response plans are not well exercised (page 92).

Recommendation 20-1. Require earthquake and tsunami (if applicable) response and evacuation drills. Keep for state review records that identify drills that had problems and describe how those problems were rectified. Require bimonthly drills for schools and annual drills for emergency response facilities, service providers, and other public buildings *(OEM, Department of Education, local school districts, local emergency managers).*

Recommendation 20-2. Require earthquake orientation or tabletop exercises annually. Consistent with available funding, require functional or full-scale exercises that focus specifically on earthquakes and earthquake-related effects every four years *(OEM, local emergency managers).*

Recommendation 20-3. Establish an exchange program for emergency managers from Oregon to observe earthquake exercises occurring in other regions of the country. Have other states' emergency managers observe and critique exercises in Oregon coastal communities *(OEM, local emergency managers).*

Recommendation 20-4. Local emergency management organizations should use nonemergency events such as parades and festivals to exercise and improve command, response, and coordination functions that will be essential in the event of an earthquake or similar disaster *(local governments).*

Issue 21—Communication networks are insufficient to deal with a large earthquake (page 94).

Recommendation 21-1. Establish community low-power radio networks for the dissemination of public emergency information during and after a large earthquake *(local emergency managers, local organizations).*

Recommendation 21-2. In cooperation with an officially designated radio or television station, evaluate the emergency broadcasting system in each coastal region; on the basis of the outcome, make the system fully operational. In addition, ensure (1) that emergency broadcast stations are well protected against physical damage caused by a potential catastrophic event, (2) that station personnel are well prepared and versed in proper emergency procedures, and (3) that other stations, if still operational after a disaster, simultaneously broadcast the same information as that sent by the designated emergency broadcasting stations *(OEM, local emergency managers).*

Recommendation 21-3. Establish uniform and effective tsunami warning systems using siren and voice communication in coastal communities and vulnerable rural centers that lack them. Ensure that citizens and visitors are aware of the system by publishing information in phone directories and other local publications and by requiring postings at public places, restaurants, rental units, and motels *(local emergency managers, OEM, DOGAMI, National Oceanic and Atmospheric Administration—Pacific and Alaska Tsunami Warning Centers).*

Recommendation 21-4. Review the structural integrity (that is, ability of a system to withstand a catastrophic earthquake) of all parts of state and county emergency communication systems and infrastructure, and retrofit where needed *(BCD, DOGAMI, local building officials, private sector).*

Recommendation 21-5. Establish communication systems recovery teams to evaluate systems and make them operational after an earthquake *(local emergency managers).*

Recommendation 21-6. Establish contingency plans to organize local postdisaster communication networks among HAM radio, marine radio, CB radio, and other informal communication systems (such as low-power radio) as an adjunct to the formal communication system *(local emergency managers).*

Recommendation 21-7. Establish emergency communication systems within schools, using, for example, walkie-talkies (see FEMA Bulletin 88, *Guidebook for Development of a School Earthquake Safety Program*) *(local school officials).*

Issue 22—Physical infrastructure, lifelines, and utility systems will be severely disrupted in the event of a large CSZ earthquake (page 96).

Recommendation 22-1. Evaluate highways, roads, bridges, airports, harbors, and railroads for their vulnerability to earthquake or tsunami damage, using existing geologic information and a credible CSZ earthquake scenario. Publish and distribute the results of the evaluation, identifying transportation infrastructure likely to be damaged, the infrastructure that would be most easily restored, and the areas likely to be isolated after a large CSZ earthquake. Also provide an estimated timetable for re-establishment of transportation infrastructure and linkages in coastal communities based on likely scenarios *(Oregon Department of Transportation [ODOT], U.S. Forest Service, Bureau of Land Management, USACOE, and railroads).*

Recommendation 22-2. Evaluate utilities, including water (and all types of dams), sewer, electricity, and gas systems and pipelines for their vulnerability to earthquake damage, using existing geologic information and a credible CSZ earthquake scenario. Publish and distribute the evaluation results, identifying utilities and associated infrastructure likely to be damaged during a large earthquake. Also provide an estimated timetable for re-establishing utility services to coastal communities based on likely scenarios *(Oregon Public Utilities Commission, Oregon Water Resources Department, public and private utilities).*

Recommendation 22-3. Evaluate the vulnerability of coastal ports to seismic hazards and tsunamis. Develop appropriate disaster preparedness and response plans for ports to address the varying levels of a potentially catastrophic event *(OEM, ports, local emergency mangers, USACOE, FEMA, Pacific Coast Congress of Port Managers and Harbor Masters, Sea Grant programs).*

Recommendation 22-4. Require continuing education on structural codes and design standards for seismic and tsunami-prone areas for designers, engineers, architects, contractors, and building officials working in coastal areas *(BCD, licensing boards).*

Issue 23—Coastal communities do not have postdisaster recovery and reconstruction plans in place (page 99).

Recommendation 23-1. Develop postdisaster reconstruction plans based on damage projections from a CSZ earthquake and tsunami. Establish a state postdisaster planning and recovery task force to plan for reconstruction and serve as the lead state coordinating body to oversee postdisaster reconstruction. Membership of the task force should include DLCD, ODOT, DOGAMI, OSSPAC, OEM, the State Fire Marshall, and other relevant agencies *(OSSPAC, State Legislature).*

Recommendation 23-2. Develop postdisaster reconstruction plans for cities and counties based on damage projections from a CSZ earthquake and tsunami. Establish city and county task forces to plan for reconstruction and oversee local postdisaster reconstruction activities. Assign to each task force a structural engineer, a sanitarian, a fire marshal, a geologist, an engineering geologist, a civil engineer, an emergency manager, and building officials *(OSSPAC, State Legislature, local emergency managers).*

Introduction

Introduction

Natural forces, some cataclysmic and some gradual and relentless, have shaped the Oregon coast over millions of years. The rocky shores and islands, rugged basalt cliffs and headlands, intricately carved sandstone bluffs, sand and cobble beaches, high dunes, estuaries, river valleys, and mountains that make up the coast owe much of their natural beauty and diversity to these forces. The dynamic processes responsible—crustal uplift and subsidence, earthquakes and volcanic eruptions, sea level change, storms and ocean waves—are still at work today, constantly reshaping the coast.

What is different about the coast today from the distant past is our ubiquitous human presence—our cities and towns, ports and harbors, and network of highways and utilities. From nearly any coastal vantage point, evidence of human presence is apparent and growing. One of the consequences of this growing presence is that the same natural forces that have shaped the coast so attractively in the past increasingly threaten human life and property. Severe winter storms, large waves, rain, high winds, and strong tides and nearshore currents cut into beaches and dunes; undermine sea cliffs, causing slumping and slides; and flood low-lying coastal lands. In recent years, the vulnerability of the coast to large, locally generated earthquakes and tsunamis has become widely accepted, adding this potential threat to the reality of the hazards we already experience.

In response to these threats and to expressed concerns that existing efforts to cope with them were inadequate, Oregon Sea Grant sponsored a conference in 1991 to present the results of recent scientific research on coastal hazards and discuss its implications for the coast. Conference participants concluded that new information about natural hazards and development practices warranted a thorough evaluation of public policy dealing with coastal natural hazards. This led in 1992 to formation of the Coastal Natural Hazards Policy Working Group (PWG).

Who is the Policy Working Group?

Organized and facilitated by the Oregon State University (OSU) Extension Sea Grant Program with support from Oregon's Coastal Management Program, the 20-member PWG (Appendix A) was drawn from attendees of the coastal hazards conference who expressed interest in serving. The group included individuals with a variety of coastal interests—oceanfront property owners, realtors, environmentalists, a consulting geologist, local planners, a school teacher, a county commissioner, an emergency manager, a fire chief, and managers from key state and federal agencies.

What was the mandate of the Policy Working Group?

The PWG had no formal mandate and so defined its own mission as follows: *Representing a broad range of public and private interests, the PWG is identifying important coastal natural hazard issues, evaluating existing management strategies, examining alternatives, and recommending and supporting needed policy improvements to decision makers at all levels.*

At the outset, the PWG's voluntary effort attracted support for its work. For example, the leaders of Oregon's Coastal Management Program, responding to 1990 amendments of the federal Coastal Zone Management Act, designated the PWG process as the centerpiece of its strategy to develop improved policies and programs for coastal natural hazards management. The Oregon Seismic Safety Policy Advisory Commission (OSSPAC), established by the state legislature to provide advice on how Oregon should address its vulnerability to earthquakes, invited the PWG to serve as an advisory group.

As the PWG process evolved, several underlying goals for dealing with coastal hazards problems emerged that guided the work of the group as they identified issues, formulated

options, and made recommendations. These goals were

1) to reduce loss of human life and property due to natural or human-caused hazards
2) to protect valuable recreational and natural resources
3) to limit regulatory approaches to hazard mitigation to that needed to protect clear, legitimate public interests as defined above

How did the Policy Working Group address the issues?

The PWG used an "all-hazards / all-decisions" approach to identify issues and options for dealing with them. These issues and options were organized for public review and evaluation and published as the *Coastal Natural Hazards Issues and Options Report* in October 1993. After a series of evaluation workshops designed to provide the PWG with the views of interested citizens and groups up and down the coast, the PWG reconvened to develop specific recommendations. This report is the result of that effort.

The PWG operated by consensus. Consequently, the recommendations presented in this report were "negotiated" and are not necessarily what an individual PWG member might have recommended independently.

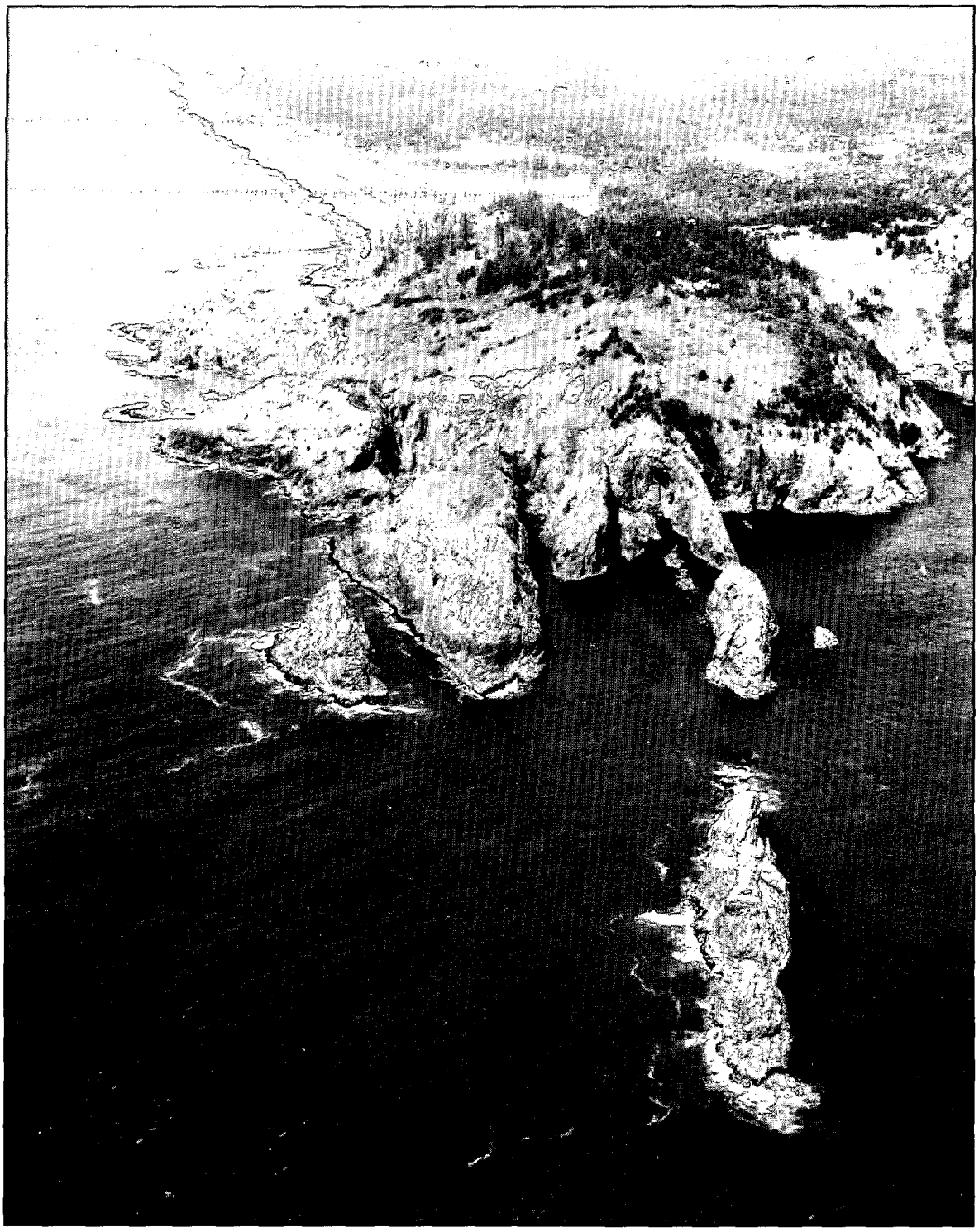
How will the recommendations be used?

A wide array of hazard-related recommendations affecting numerous agencies, organizations, and individuals are outlined in this report. Thus, it is likely that there will be many routes to adoption and implementation. In response to options presented in its earlier report, several of the PWG recommendations are already being implemented or are the basis for legislative proposals. Other recommendations may be adopted directly or adapted by relevant agencies or organizations. For example, parts of Oregon's Coastal Management Program may be revised to incorporate certain recommendations. Individuals who served on the PWG as private citizens may ask their representative or senator to introduce legislation dealing with recommendations they especially want to see implemented. State agencies or representatives of local jurisdictions may translate some of the recommendations into administrative rules, policies, or ordinances. There will certainly be other unanticipated routes to implementation.

What is this report and how is it organized?

This is the final report of the PWG. It provides background on the PWG process, identifies 23 coastal natural hazard issues, summarizes the findings of the PWG for each issue, makes 79 specific recommendations for dealing with the issues, and suggests actions needed to implement each recommendation.

The introduction to this report gives a brief overview of the work of the Coastal Natural Hazards Policy Working Group: how it came to be, how its members were selected, what its mission was, and how it developed its recommendations. The overview is followed by a description of the natural hazards that affect the coast and existing policies and programs designed to mitigate them. The process used by the PWG to develop its recommendations is described next. This is followed by the main body of the report: the issues and recommendations. The issues and recommendations are divided into four subsections: hazard assessment, shore protection, land use, and disaster preparedness and response. Finally, there are references and several appendices: Appendix A-PWG Members and Support Team; B—Glossary of Terms and Acronyms; C—PWG Process and Meeting Schedule; and D-Earthquake Education Strategy.



The Heads at Port Orford on the southern Oregon coast (ODOT photo).

Coastal Natural Hazards and Policy in Oregon

Coastal Natural Hazards and Policy in Oregon

Natural Hazards Along the Oregon Coast

The tectonic setting of the Pacific Northwest is very important to the evolution and present character of Oregon's coastal landforms, and the geologic, oceanic, and atmospheric processes that contribute to natural hazards. From a tectonic perspective, the Pacific Northwest is a continental collision coast characterized by a relatively straight shoreline, raised terraces, narrow continental shelf, volcanism and seismicity. Just offshore is the 700-mile long Cascadia subduction zone (CSZ), the boundary between the westward-moving continental North American plate and the northeast-moving Juan de Fuca plate (figure 1).

As a consequence of its tectonic setting, the Oregon coast is mountainous, with rocky headlands segmenting the shore into pocket beaches of varying lengths (figure 2). Seventeen coastal rivers drain the Coast Range and Klamath Mountains, discharging into the sea where they form estuaries. At a finer scale, the coast is highly irregular with a variety of landforms and rock types of varying ages and origins (Snavely 1987). Rocky headlands composed of Tertiary basalts are one of the most prominent coastal features, often several hundred feet high and jutting seaward more than a mile. These, and other headlands composed of erosion-resistant sedimentary rocks, divide the Oregon coast into a series of 22 discrete littoral cells and subcells (Peterson et al. 1991). Much of the coastline between these headlands is sea cliffs, composed of more erodible sedimentary sandstones, siltstones, and mudstones of different ages. These cliffs are generally fronted by beaches of varying width and composition. The sea cliffs along the central Oregon coast and parts of the south coast are mostly uplifted marine terrace sands and silts of Pleistocene origin. At the river mouths, narrow, unstable bay-barrier sand spits are common, some extending north and others south to form the ocean side of estuaries. Large coastal sand dunes are another prominent feature of the northern and central coast, including Clatsop Plains north of Tillamook Head, Sand Lake dunes just south of Cape Lookout, and the nearly 50-mile long dune sheet extending from Cape Perpetua south to Coos Bay. Most of the latter dunes are part of the Oregon Dunes National Recreation Area. Of the 362 miles of Oregon coastline, 100 miles (28 percent) are rocky shore and 262 miles (72 percent) are sandy beach shores,

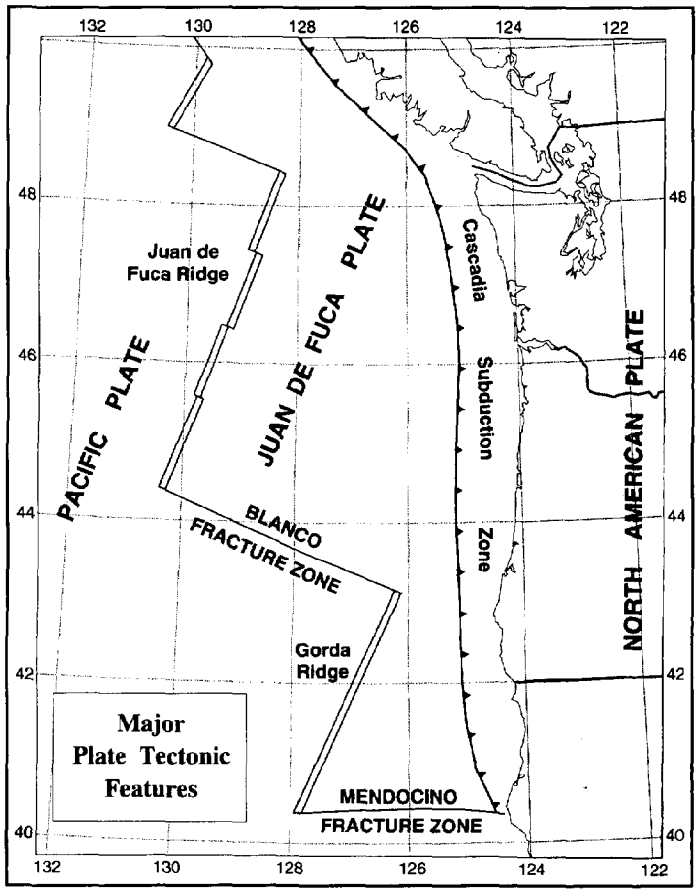


Figure 1.—Major plate tectonic features of the Pacific Northwest (source: Atlas of the Pacific Northwest, *OSU Press).*

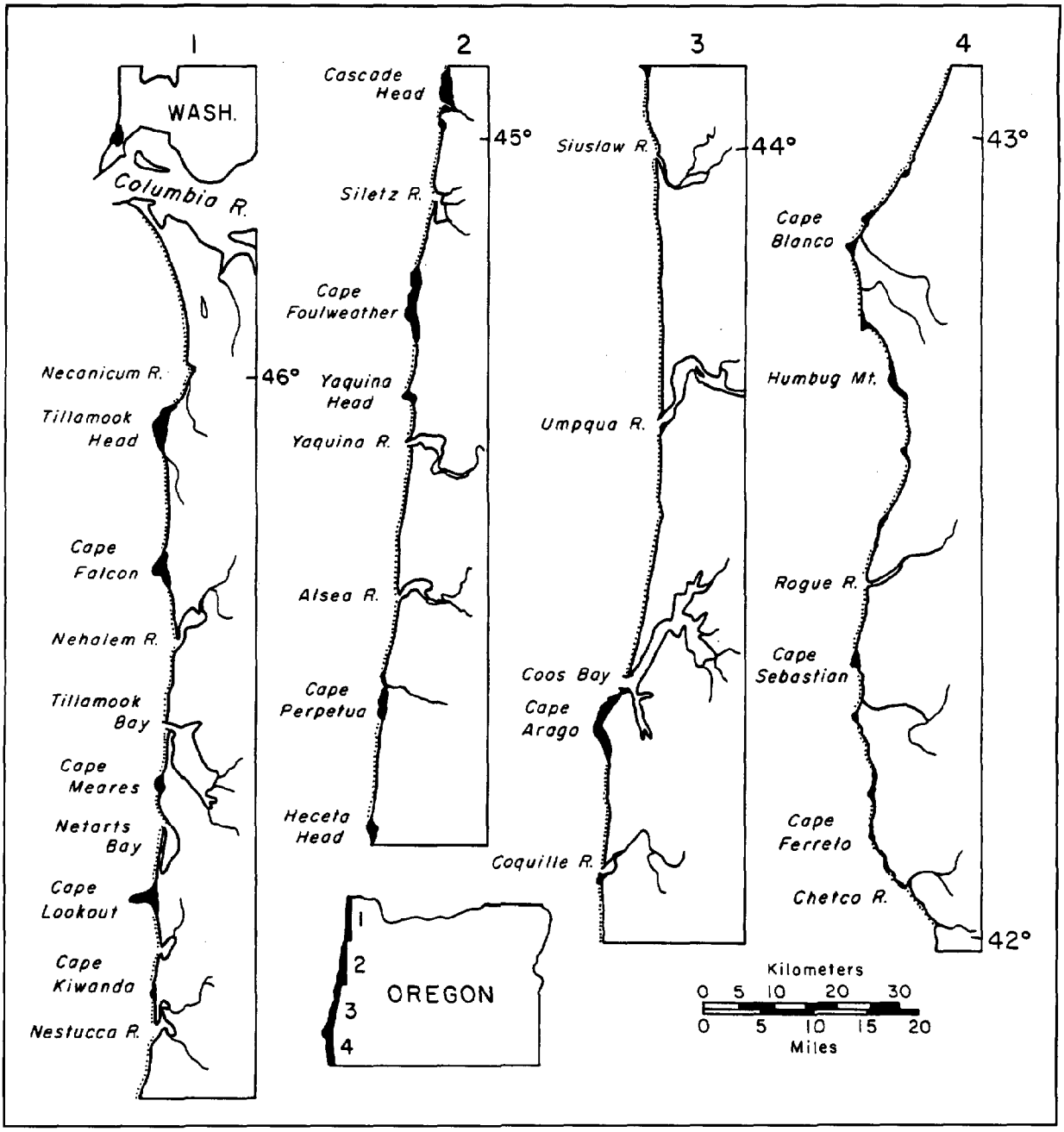


Figure 2.—Features of the Oregon coast, including major headlands (in black) that divide the coast into discrete beach segments or littoral cells.

including those backed by sea cliffs, dunes, and spits.

Natural hazards that affect the coast can be divided into two general classes—chronic and catastrophic. Chronic hazards are those we can see clear evidence of along the shore—beach, dune, and bluff erosion; slides, slumps, and gradual weathering of sea cliffs; and flooding of low-lying lands during major storms. Within some cells, excess sand buildup is periodically a problem for existing and new development. These hazards occur with a relative degree of predictability and affect only limited areas at any given time. The damage

they cause is usually gradual and cumulative. Chronic hazards along the coast owe their severity to the regional oceanic and climatic environments (Komar 1992) that result in large winter storms with waves up to 30 feet high; associated storm surge and wave setup along the beach and shoreland; strong nearshore currents, including rips; high winds, rain, runoff, and associated lowland flooding; and elevated sea levels, caused by seasonal effects and periodic El Ninos. Long-term sea level rise associated with global warming poses no immediate risk along the north and south coasts of Oregon because coastal emergence rates exceed long-term sea level rise. However, sea level rise is a problem along approximately 150 miles of the central coast, where coastal uplift is minimal. Although public policies addressing natural hazard mitigation tend to focus on these chronic coastal hazards (except for sea level rise), there have been significant problems with how they have been implemented.

Catastrophic hazards are those associated with earthquakes, three types of which may occur in the Pacific Northwest coastal region: crustal, intraplate, and subduction zone (Madin 1992). Crustal earthquakes occur on local faults along the coast and may be as large as magnitude 6-6.5 on the Richter scale. Recent crustal quakes in Oregon were the March 25, 1993 Scotts Mill quake (magnitude 5.6) and the September 20, 1993 Klamath Falls quakes (magnitude 5.9 and 6.0). Despite their relatively small size and rural epicenters, both caused significant property damage. Intraplate

The central Oregon coast dune sheet extends nearly 50 miles and includes dunes up to 700 feet high (ODOT photo).

earthquakes occur along the subducting Juan de Fuca plate, deep below the surface under the Coast Range and western Willamette Valley. The Puget Sound area has experienced intraplate quakes as large as magnitude 7.1 (1949) and 6.5 (1965), but no historic events have been documented in Oregon. Very large earthquakes are believed to occur along the CSZ. While there have been no major historic subduction zone earthquakes along this 700-mile long fault (there was a magnitude 7.1 event in April 1992 at the extreme south end of the subduction zone), there are several converging lines of evidence for powerful earthquakes in the magnitude 8 to 9+ range. These include geodetic measurements of accumulating uplift strain (Weldon 1991), tide gauge data from a variety of coastal locations (Shih 1992), sequential dating of abruptly submerged peat deposits in salt marshes along the coast (Darienzo and Peterson 1990), records of offshore turbidity current deposits (Adams 1990), and the archeological record (Woodward et al. 1990). Estimated recurrence intervals range from 340 to 590 years; the last large quake was about 300 years ago, placing the probability of another event in the next 50 years at 10 to 20 percent (Priest pers. comm., October 20, 1992).

The scenario for a large CSZ earthquake is sobering: severe ground shaking lasting up to four minutes; liquefaction of saturated, unconsolidated soils such as sand or silt; numerous and possibly massive landslides; land subsidence and flooding, particularly along the central and north coasts; and a series of large tsunami waves beginning to arrive soon after the event. All of these hazards occurred during the 1960 Chilean subduction zone earthquake—probably a good comparison for a CSZ event—with heavy loss of life and property. Tsunamis generated by distant earthquakes occurring along the Pacific rim are also a hazard along the Oregon coast. The 1964 Alaska earthquake, for example, caused significant damage within many of Oregon's coastal estuaries.

Coastal Natural Hazards Management

The existing management framework for mitigating coastal natural hazards in Oregon includes local, state, and federal laws and policies implemented through a variety of programs and government agencies. Historically, in Oregon at least, state and local governments have played the most significant role in hazards management. These roles, divided into four categories—hazard assessment, shore protection, land use planning and development, and disaster preparedness and response—are summarized in table 1, with more detail below.

Hazard Assessment

Hazard mapping, research, and mitigation assistance in Oregon are the responsibility of the Department of Geology and Mineral Industries (DOGAMI). In the early 1970s, DOGAMI published environmental geology maps and assessments for all coastal counties that served as basic hazard inventories for many years. Oregon's coastal management agency, the Department of Land Conservation and Development (DLCD), required local governments to develop and use these and other natural hazard inventories in their local comprehensive planning process. However, much of the information used for the inventories was general and has proven to be of limited use for specific sites. DOGAMI and DLCD have begun more detailed hazard assessment work recently, as discussed later in the recommendations section of this report.

Shore Protection

The typical response to shoreline erosion or slumping along developed portions of the Oregon coast has been to install a seawall or riprap revetments—referred to as "hard" shore protection structures (SPSs) throughout this report. The installation of SPSs along the oceanfront is regulated by two state laws: the Beach Law (ORS 390.605-390.770) and the Removal/Fill Law (ORS 196.800-196-990). These laws are administered as a joint permit program by the Oregon Parks and Recreation Department (OPRD) and the Division of State

Table 1. Governmental functions and agencies or authorities for coastal natural hazards management in Oregon.

Governmental Function	*Federal Government*	*State Government*	*Local Government*
Hazard research, assessment, and mapping	■ U.S. Geological Survey: geological hazards ■ Federal Emergency Management Agency (FEMA): flood and erosion hazards ■ U.S. Army Corps of Engineers (USACOE): erosion hazards	■ Dept. of Geology and Mineral Industries (DOGAMI): hazards info and mapping ■ Dept. of Land Conservation and Development (DLCD): inventory standards ■ Universities/Sea Grant: research	■ Local Comprehensive Plan (LCP): hazards inventory and maps
Shore protection	■ USACOE Nationwide Permit No. 13: bank stabilization	■ Oregon Parks and Recreation Department (OPRD): Beach Law regulates shore protection structures ■ Division of State Lands (DSL): Removal/Fill Law regulates revetments and fill	■ LCP and development ordinances (shore protection provisions vary)
Land use planning and development	■ FEMA: National Flood Insurance Program (NFIP) ■ FEMA coastal and flood construction standards	■ DLCD statewide planning standards: Goal 7: Natural Hazards Goal 17: Coastal Shorelands Goal 18: Beaches and Dunes ■ Building Code Division: building standards	■ State-approved LCP with natural hazards, shorelands, beaches, and dunes elements; local subdivision, zoning, and flood damage prevention ordinances ■ Local building code administration: city and county
Disaster preparedness and response	■ FEMA: federal response and aid coordinator ■ USACOE: cleanup, construction, waterway assistance	■ Oregon Emergency Management Division (OEM): disaster response and planning ■ Oregon Seismic Safety Policy Advisory Commission (OSSPAC): earthquake/tsunami policy and planning	■ Emergency management: Counties ■ Law enforcement, fire, medical: Counties/Cities

Lands (DSL), respectively. The emphasis in both laws is on protecting public recreation values and access to and along the beach. Both agencies regulate the riprap revetments and seawalls installed along the shore to control erosion and bluff slumping, though their jurisdictions differ somewhat. OPRD regulates all types and sizes of structures, but their geographic jurisdiction is limited to structures that extend west of a beach zone line (BZL) that was surveyed in 1967, just after the Beach Law was passed. DSL, on the other hand, only regulates structures involving 50 cubic yards or more of material, but their geographic jurisdiction is not fixed and extends to the upland vegetation line. Statewide planning Goal 18 (Beaches and Dunes) also plays a role in regulating shore protection. The goal prohibits beachfront protective structures in areas that were not developed or physically improved as of January 1, 1977. "Development" is defined as houses, commercial and industrial buildings, and vacant subdivision lots that are physically improved through construction of streets and provision of utilities to the lot, or areas where special exceptions have been approved. For SPSs, the goal also requires that visual impacts must be minimized and necessary access to the beach be maintained, and that negative impacts on adjacent property, and long-term or recurring costs be minimized.

The U.S. Army Corps of Engineers (USACOE) regulates installation of SPSs under section 10 of the Rivers and Harbors Act of 1899 and section 404 of the Clean Water Act. The Portland District USACOE issued a nationwide permit for "bank stabilization" (NWP 13), with regional conditions for Oregon, effective February 14, 1992. NWP 13 effectively removes the Corps from the majority of day-to-day shore protection decision making. Concerns about present shore protection regulatory programs are addressed in the recommendations section of this report.

Land Use Planning and Development

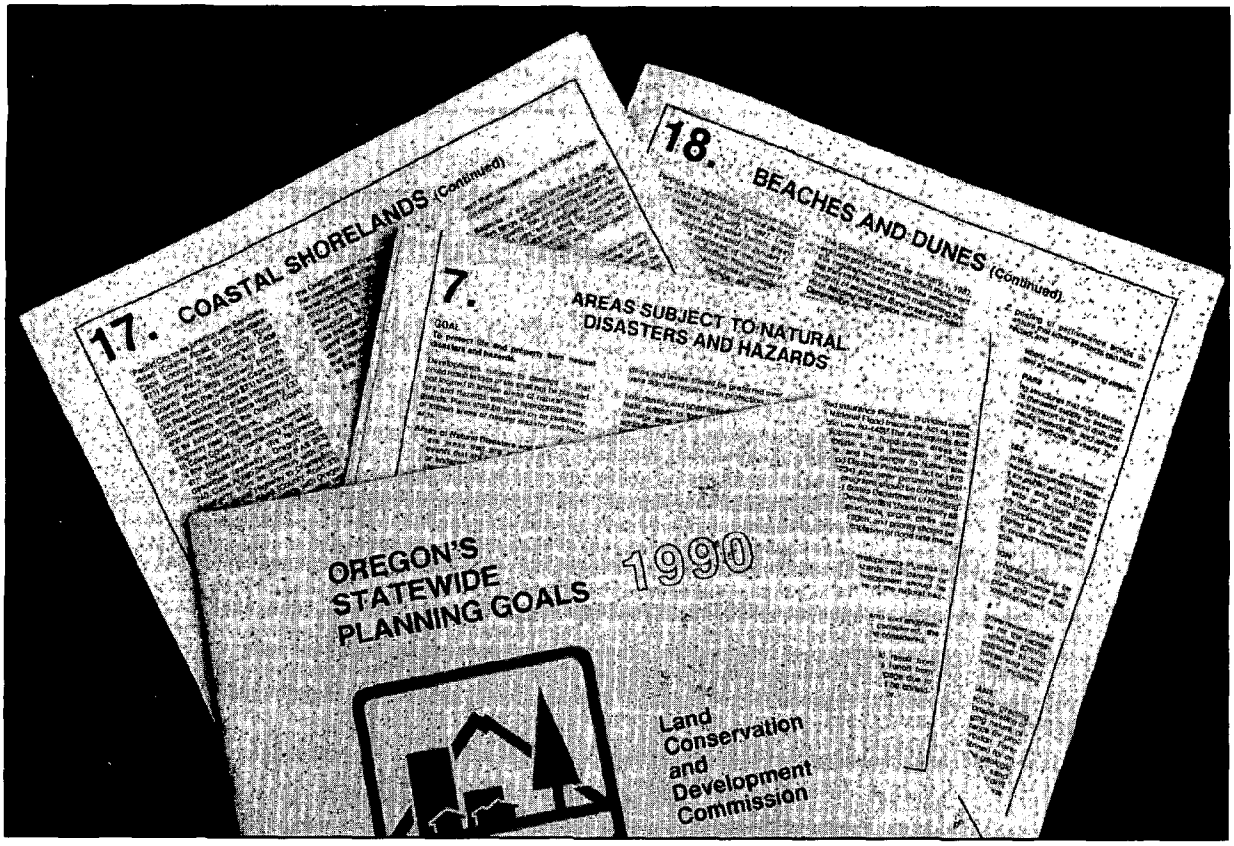
Oregon's statewide land use planning program, overseen by the Land Conservation and Development Commission (LCDC), includes hazard-related planning goals used by local governments to develop local comprehensive plans. Three goals apply directly to hazards management. LCDC Goal 7—Natural Hazards, mandates that development subject to natural hazards not be located in known areas of natural hazards without appropriate safeguards. LCDC Goal 17—Coastal Shorelands, requires that local comprehensive plans consider geologic and hydrologic hazards along shorelines, giving preference to nonstructural mitigation techniques to solve erosion and flooding problems. LCDC Goal 18—Beaches and Dunes, prohibits development on hazardous dune and interdune lands, prohibits breaching of foredunes, and sets hazard mitigation conditions on development on more stable dunelands.

Cities and counties were required to address these and other policies in their local comprehensive plans, which were then reviewed and approved by the state. All coastal jurisdictions completed their initial round of planning in the early 1980s and have state-acknowledged plans and implementing ordinances. Specific provisions in local plans for regulating development in hazardous oceanfront areas vary. All counties have required construction setbacks, either fixed or variable, some require geologic hazard reports from a registered geologist or engineer, and some use overlay ordinances and other provisions. However, there are few standardized hazard mitigation provisions in the plans, and some are more effective than others.

The federal government gets involved in land use management indirectly through provisions of the National Flood Insurance Program, administered by local governments through the Federal Emergency Management Agency (FEMA). The Upton Jones provision of the law, passed in 1987, authorizes advance payment for relocation or demolition of any structure that is covered by a current flood insurance policy and that is subject to imminent collapse because of erosion. However, this provision has not yet been applied in Oregon and it is not likely to be an important management tool. Most of the erosion-related property loss is for bluff-top areas where residents do not have federal flood insurance.

Disaster Preparedness and Response

Numerous agencies are involved in disaster preparedness and response. At the national level, the Federal Emergency Management



Planning Goals 7, 17, and 18 provide guidance for development in hazardous areas but have serious limitations (J. Good photo).

Agency (FEMA) takes the lead, with the U.S. Army Corps of Engineers and many other agencies in support. FEMA's counterpart at the state level is the Oregon Emergency Management Division (OEM), now a unit under the Oregon State Police. At the local level, counties are in charge of emergency management and disaster preparedness, with cities and special districts usually coming under their jurisdiction. The American Red Cross and other private relief agencies also play important roles in disaster preparedness and response. Each agency is charged with certain responsibilities for disaster preparedness, mitigation, response and recovery planning, and plan exercises.

Effective disaster preparedness and response are vital, regardless of the hazard. However, because of the lack of major historic coastal earthquakes or tsunamis, it has been difficult to plan effectively and execute a response. Many agencies are just now in the process of preparing plans that are specific to coastal earthquake and tsunami hazards. Effective planning will require the active involvement of people in local government, law enforcement, fire and medical services, transportation, health and human resources, schools, and businesses and local citizens. Concerns about the present preparedness and response capacity of responsible agencies as it relates to a CSZ earthquake are addressed in the recommendations section of this report.

The Policy Working Group Process

The Policy Working Group Process

Developing a Policy Improvement Strategy

By 1992, several indicators suggested the need for a comprehensive review of Oregon's coastal natural hazards management framework, including new research findings on earthquakes and other coastal hazards (Madin 1992; Komar 1992), accelerating coastal growth (Jones 1993), and recent evaluations of hazard-related policies and practices (Good 1992; DLCD 1992). However, given the relatively low profile this set of problems presented in comparison to state budget shortfalls, funding for education, health care, and salmon recovery, the continuing timber crisis, and other state and national issues, the key question for coastal managers was how to develop workable policy improvements and, at the same time, get the attention of the policymakers who would be needed to initiate legislative and administrative changes. The resulting strategy involved (1) a major conference to focus attention on the issues, (2) the formation of an ad hoc policy working group to examine issues in more detail and make recommendations for improvements, and (3) a gradual effort to build credibility and support for needed changes, first at the grassroots level, and later with state agency leaders and legislators.

The Coastal Natural Hazards Conference

In October 1991, Oregon Sea Grant and a number of state agencies and local organizations sponsored a coastal hazards conference in Newport, Oregon, aimed at coastal residents, public officials and resource managers, realtors, developers, and environmentalists. The purpose of the conference was to present what scientists and engineers have learned in recent years about coastal natural hazards, what their findings mean for coastal residents, visitors, and officials, and what kinds of public policies might be needed to address these hazards. Probably the most significant concern of participants was the potential for a large subduction zone earthquake and our lack of preparedness. Other concerns were rapid growth in coastal high-hazard areas and limited hazard information and education on these issues. Papers presented at the conference were published by Oregon Sea Grant—*Coastal Natural Hazards: Science, Engineering, and Public Policy* (Good and Ridlington 1992). In addition, the results of "focus group" discussions at the conclusion of the conference identified a variety of problems and concerns that needed to be addressed. Participants expressed great interest in delving into these issues in more detail and working to find acceptable solutions. This led to formation of the Coastal Natural Hazards Policy Working Group.

Selection and Support of the Policy Working Group

Much of the credibility of the policy process came from the PWG's diverse membership. The 20 members of the group were selected from among those who attended the coastal hazards conference, with representatives from a range of "stakeholders" with different perspectives and interests—oceanfront property owners, builders, realtors, consultants, local officials and planners, state and federal regulators and resource managers, environmentalists, educators, and others. Representatives of the state and federal agencies with major responsibilities for coastal hazards management were also included in the group.

The group was supported by a team from the OSU Extension Sea Grant Program with funding from the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resources Management, through Oregon's Coastal Management Program (OCMP) and DLCD. A Technical Advisory Committee, an Education Advisory Committee, and a number of other experts on hazard-related topics also assisted the PWG.

Stages and Features of the PWG Process

The PWG process had three stages: I—issue and option generation; II—evaluation and public feedback on draft policy options; and III—development of recommendations to policymakers. These are illustrated in figure 3 and described below. Two features of the PWG process are particularly noteworthy: the comprehensive all-hazards/all-decisions methodology and the structured, consensus-based workshop process.

All-Hazards/All-Decisions Approach

There are many public and private decision-making situations in which the effects or potential effects of coastal natural hazards may

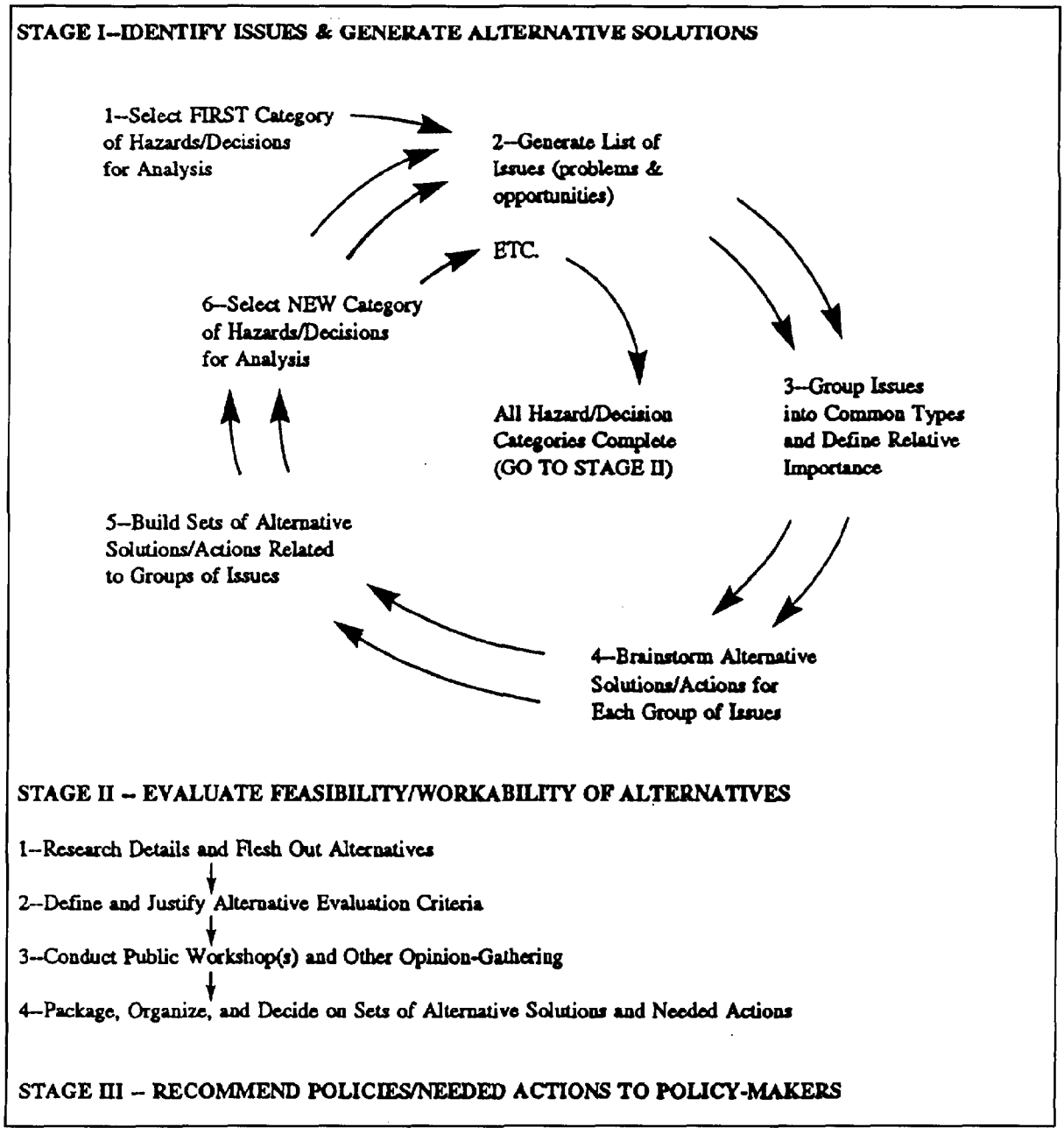


Figure 3.—Process used by the Coastal Natural Hazards Policy Working Group.

be important. To provide an entry point for the complex policy development process that was undertaken by the PWG, an all-hazards, all-decisions approach was developed and used to integrate hazard-related problems with potential solutions. A matrix of decisions versus hazards was developed to represent this approach conceptually (figure 4).

Stage I: Issue and Option Identification

Stage I of the process involved 10 two-day PWG workshops and several meetings of the

	Chronic Hazards					Catastrophic Hazards					
Private/Public Decisions	Eros	Recess	Slide	Flood	SLR	Gr-shak	Fault	Sub/Flo	Liq/set	Slide	Tsun/Sei
Locating private development in **undeveloped areas**											
Locating public infrastructure and facilities in **undeveloped areas**											
Designing private development in **undeveloped areas**											
Designing public infrastructure and facilities in **undeveloped areas**											
Protecting private development in **undeveloped** areas											
Protecting public infrastructure and facilities in **undeveloped** areas											
Locating private development in **infill** areas											
Locating public infrastructure and facilities in **infill** areas											
Designing private development in **infill** areas											
Designing public infrastructure and facilities in **infill** areas											
Protecting private development in **infill** areas											
Protecting public infrastructure and facilities in **infill** areas											
Locating private development in **developed** areas											
Locahng public infrastructure and facilities in **developed** areas											
Designing private development in **developed** areas											
Designing public infrastructure and facilities in **developed** areas											
Protecting private development in **developed** areas											
Protecting public infrastructure and facilities in **developed** areas											
Emergency respon se planning											
Post-disaster reconstruction planning											

Each of the PWG workshops was organized around a limited set of hazards and decisions (for example, the area within the shaded box served as the basis for a single workshop).

Figure 4.—All-hazards/all-decisions matrix used in the policy working group process.

advisory committees and each of the PWG work teams (see Appendix C for details). The matrix served as a guide to focus the initial PWG workshops on a limited set or block of issues at any one time; for example, one workshop focused on the group of cells that represented "chronic hazards as they affect the location of development in undeveloped areas." This and other blocks of cells were used to identify issues and generate potential solutions in a series of structured, brainstorming workshops. Though the brainstorming process was structured, all issues (an issue is defined as a problem, concern, or opportunity) and solutions were accepted in a nonjudgmental manner. These data were recorded and posted, serving as a kind of "group memory." After each workshop, these raw data were reviewed and folded into an ongoing "working list," using natural groupings such as hazard assessment, shore protection, land use, disaster preparedness and response, education, and so on. As the working list was gradually built through the 10 Stage I workshops, many overlapping issues and options became apparent and were combined. This working list was the raw material for developing the "issues and options report" that was published in Stage II. By waiting until all hazards and decisions had been examined before developing the final issues and options list, the PWG was able to formulate a more comprehensive set of policy options and to integrate chronic and catastrophic hazards with related public and private decision making.

Stage II: Evaluation of Issues and Options

In Stage II of the process, three additional two-day PWG workshops and many more small work group meetings were held to transform the working list into the *Coastal Natural Hazards Issues and Options Report*, published in October 1993. In the report, the PWG identified 27 significant coastal hazard policy issues and categorized them into four groups: Hazard Assessment, Disaster Preparedness and Response, Land Use, and Shore Protection. For each issue, there were a range of options or potential solutions for dealing with the problem or concern each issue represented. Accompanying the report was a detailed evaluation form that asked reviewers to provide feedback on the issues and options.

There were three principal purposes for the Issues and Options Report, the evaluation process, and the public workshops:

1) to share important hazard-related issues that coastal residents, visitors and managers face today and in the future
2) to suggest that there are a variety of solutions or "options" for dealing with these issues
3) to ask reviewers to evaluate each of the options, to state their preferences, and give the PWG other ideas for solving identified problems

More than 700 copies of the issues and options report were distributed at workshops and by direct mail to coastal residents, local officials, state agencies, planners, and others interested in or affected by these issues, along with the evaluation forms. Eleven workshops were held with interested groups along the coast and more than 500 people participated (table 2). Some 65 individuals completed the full evaluation form, a process that required reviewers to read the full report and then evaluate each of the options—about a three- to five-hour task. Although the data gathering effort was not "scientific" in a statistical sense, it did provide the PWG with some very useful written comments and a general sense of what interested reviewers thought about each of the options.

The evaluation process had three parts. First, for each of the options associated with an issue, reviewers were asked to evaluate how well the option answered the following question and rate the option accordingly:

On the whole, how would you judge this option, considering its potential effectiveness, public cost, private cost, and political feasibility?

Rating

Poor		*Neutral*		*Excellent*
1	2	3	4	5

Next, after evaluating each of the options, evaluators checked the box for the option(s) that they wanted to see included in the PWG's final recommendations. Finally, reviewers were asked to make comments on each issue and to suggest new option ideas.

Table 2. Coastal Natural Hazards Issues and Options Report Evaluation Workshop Schedule and Results (1993).

Group	Date-Time-Location	Notes (PWG involvement, attendance)
OCZMA, Inc.	Sep 16, 1100, Florence	Peg Reagan, Jeri Allemand (50 participants, preliminary results)
Curry County Earthquake Workshop	Oct 16, 1100, Gold Beach	Jeri Allemand, Peg Reagan, Phyllis Cottingham, Jim Good (150 participants)
ONCR Coast/Ocean Conf.	Oct 17, 0830, Newport	Ellen Warring, Emily Toby, Jim Good (about 40 participants)
Oregon Seismic Safety Policy Advisory Comm.	Nov 5, 1130, Salem	Peg Reagan, Emily Toby, Jim Good (20 participants)
League of Oregon Cities	Nov 8, 1345, Eugene	Jeri Allemand, Jim Good (Marilyn Schafer, Gold Beach Mayor presided) (35 participants)
Tillamook Board of Realtors	Nov 9, 0800, Tillamook	Patricia Williams/Vic Affolter, Jim Good (about 45 participated)
Coastal Planners, Building Officials, State Managers	Nov 12, 1300, Newport	Mike Shoberg, Vic Affolter, Emily Toby, Jim Good (22 participants)
Oregon Shores Conservation Coalition	Nov 13, 1130, Newport	Ellen Warring, David Minter, Paul Salop (45 participants)
Coast Emergency Managers	Nov 16, Salem	Jeri Allemand (informal meeting with 7 coastal county emergency managers)
South Lincoln Board of Realtors	Nov 16, 1130, Newport	Teresa Atwill, Sheridan Jones, Paul Salop (60 participants)
Ocean Policy Advisory Council	Dec 10, 1500, Newport	Dennis Olmstead, Pete Bond, Ellen Warring, Jim Good (25 participants)

Stage III: Developing and Presenting Recommendations

Following the evaluation process, the PWG reconvened for Stage III of the process. They examined the results of the evaluation process and deliberated on a package of final recommendations during six additional two-day workshops, completing their work in May 1994. Again, the policies were developed through a consensus-building process and do not represent the views of any individual member, but the group as a whole.

Other Features of the PWG Process

Several features of the PWG process that were critical to the success of the group were derived or modified from several decades of experience in dispute resolution. They were as follows:

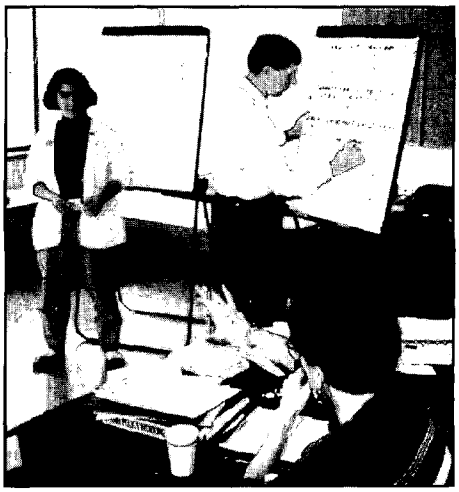
1) An open process based on the interests of "stakeholders." The diversity of stakeholders on the PWG was noted above. The PWG agreed to recognize, respect, and value the diversity of ideas and opinions held by its members. All meetings were open to observers, who were regularly consulted, and broad-based public involvement in evaluation of PWG proposals was considered essential.

2) Consensus decision making. The PWG agreed to work by consensus. Consensus meant that members had an opportunity to state their views, that they believed they were listened to, and that they could "live with" the decision, whether or not it was the same decision they would have come to independently. Because of this and the commitment to public input, the PWG strove for solutions that were effective and equitable as well as acceptable to all stakeholders.

3) Neutral facilitation and support. A neutral, third-party facilitator was engaged to assist the PWG with group processes and decision making. Creativity and new thinking in defining problems was encouraged. In part, this was stimulated by the diversity of interests represented within the PWG, and in part by the process itself. Funding for logistic and technical support for the group was provided by DLCD through federal Section 309 coastal grants. OSU, through its Extension Sea Grant Program, provided coordination, support, and management assistance.

4) The assistance of experts, educators, and researchers. Many of the subjects addressed by the PWG were highly technical and cut across many disciplines. For each topic area addressed by the PWG, expert panels were convened and resource material was provided by the support team. A research assistant researched issues in more depth when needed, a technical advisory committee developed and presented the latest scientific consensus on issues (for example, a planning scenario for a large CSZ earthquake), an education advisory committee developed a comprehensive strategy for earthquake and tsunami education, and a variety of special research projects were funded and conducted by DLCD and other agencies under the auspices of the Section 309 CZM program (for example, an all-hazards mapping pilot project).

5) Support building. Because the PWG effort was an ad hoc, bottom-up process with no formal legislative or other mandate, efforts were made throughout the process to build recognition and credibility. The evaluation process in Stage II was by far the most significant of these efforts, but other presentations to local and state officials, legislators, and others were also important.



The Policy Working Group facilitator leading the group in a consensus-building session (J. Good photo).

Issues and Recommendations

Hazard Assessment and Information Access

Accurate, up-to-date maps and information on coastal hazards at scales useful for decision making are prerequisites for the effective mitigation of natural hazards. Unfortunately, much of the available information is outdated or too generalized to be useful to decision makers.

Decision makers need answers to a variety of hazard-related questions. For example, what is the erosion and landslide history of this piece of property? How vulnerable is it to erosion? What is needed to mitigate the hazard?

More recently, questions focus on hazards associated with large earthquakes. Decision makers want to know what parts of the community are most vulnerable to tsunami inundation or what areas will experience amplified ground shaking, soil liquefaction, or subsidence. Answers to these and similar questions are urgently needed to factor the risks of coastal hazards into daily decisions. These decisions concern, for example, siting critical facilities, preparing response plans for disasters, approving new homes along the oceanfront, planning park improvements, updating comprehensive plans, and protecting beaches or upland buildings from erosion. For each purpose, the information needs, such as the required map scale or the level of technical detail or emphasis, differ somewhat.

Although some of this information is available, our increasing vulnerability to hazards, especially to large earthquakes, suggests a need for more and better information. Some of this new information can be generated at relatively low cost, but much of it will require that we collect new field data, acquire and interpret remotely sensed data, and present the information in formats that are useful to decision makers. Some hazards information will be needed for long-range planning, whereas some is more appropriate to site-specific decisions. Whatever the case, natural hazards maps and reports need to be more consistent in content and of higher quality than they now are. Information also needs to be more accessible to decision makers. Although improvements in natural hazards information will require significant public investment, the cost of inaction could be much greater.

Four issues are addressed in this section, with specific recommendations for each:

- information and mapping needs, and standards for data collection
- content standards and quality control of site-specific geotechnical reports
- information storage and improved access for users, including formal and informal hazards education for professional and general audiences
- disclosure of hazards information during property transactions

Issue 1

Existing maps and information about coastal natural hazards are inadequate for planning and decision making.

Maps, supporting data, and descriptive information on coastal erosion and accretion, landslides, and other chronic natural hazards are outdated, inconsistent, too general, or not easily accessible to many potential users. Similar information for earthquake and tsunami hazards is even more limited or simply not available. As a result, decisions that should consider these hazards are made without accurate information, placing life and property at undue risk and limiting our capacity to respond to disaster.

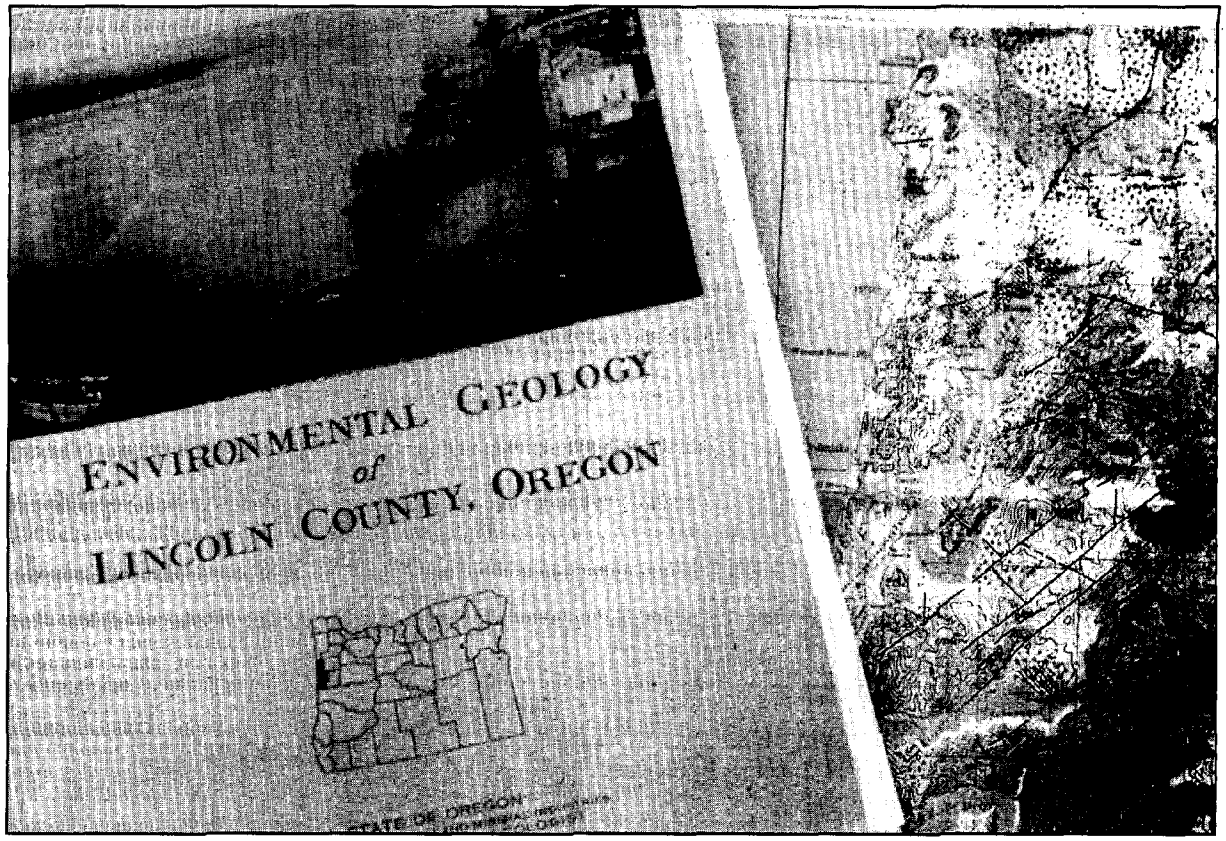
Findings

The most recent standardized coastwide mapping (1"= 1 mile) and assessment of coastal natural hazards was conducted in 1973 by the state's principal hazard research agency, DOGAMI. Since then, other more detailed hazard assessments have been conducted by most counties and cites for comprehensive land use planning. There have also been other hazard studies for dune management and development site planning or shore protection, and FEMA has mapped flood hazards, including oceanfront "velocity" zones. In the last decade, however, there have been significant advances in understanding coastal hazards and processes through research on beach erosion, sea cliff recession, and the impacts of shore protection structures. Incorporation of these new research results into inventories and decision making processes has been sporadic at best. Further, the state lags in the use of up-to-date hazard assessment and engineering techniques, for example, methods for assessing historic erosion rates and estimating future erosion.

Lacking accurate, up-to-date hazards information, coastal residents will make decisions with relatively unreliable information. The resulting hazard mitigation solutions may be either inadequate or excessive for dealing with actual risks. The consequence will be either increased long-term cost to the public, higher short-term cost to private property owners, or both.

Research on past occurrences of catastrophic earthquakes along the CSZ and the modelling of future ones are progressing rapidly. However, few maps and little supporting information are available that detail specific areas that would be vulnerable to amplified ground shaking, soil liquefaction, landslides, subsidence-induced flooding, and tsunami inundation during the next large earthquake. Such information is critical for developing reliable disaster preparedness and response plans, for making informed decisions on land use and the siting of critical facilities, and for revising structural codes and retrofitting existing structures. For low-lying coastal areas, the potential for large, locally generated tsunamis is the most serious threat because of the lack of warning time for evacuation and the resulting potential for loss of life. Cannon Beach and Seaside are two communities where preliminary tsunami run-up studies have been completed (based on paleotsunami data) and evacuation plans developed. Rockaway Beach and Manzanita have also established tsunami evacuation plans, but most other communities are poorly prepared.

DOGAMI, DLCD, OSU, Portland State University, and the Oregon Graduate Institute, have undertaken an "all-hazards" pilot program to map and describe shoreline hazards using up-to-date methods and data. The first part of the study, focusing on erosion, landslides, and other chronic hazards in a 50-kilometer stretch of the central coast, is completed. The second part, dealing with seismic hazards in the south Lincoln City-Siletz Bay area, is slated for completion in late 1994. Researchers in the project are emphasizing the potential for coseismic landslides, ground acceleration, liquefaction, subsidence-induced flooding, and tsunami inundation. Both parts of the study are funded under Section 309 of the federal Coastal Zone Management Act (DLCD 1992). The catastrophic hazards mapping is also supported by FEMA and Oregon Sea Grant. This all-hazards mapping project



Natural hazard inventories and maps of coastal areas were completed in the early 1970s by DOGAMI. They are too general and small in scale to be useful for site-specific work (J. Good photo).

serves as a model for what is needed all along the coast. Development of these maps requires collecting all relevant information and establishing mapping criteria and standards. The resulting maps and data should be useful for long-range planning as well as site-specific development and shore protection decisions.

A number of other efforts are underway to research and map earthquakes and tsunamis. DOGAMI scientists are mapping and interpreting catastrophic hazards and risks for the Portland area, using a red-yellow-green "stoplight" map to illustrate the combined hazards of slope, rock type amplification, and liquefaction potential (Mabey et al. 1993). Portland State University researchers are seeking funding to develop tsunami inundation maps based on paleotsunami data (marsh sedimentary records), and NOAA's Pacific Marine Environmental Lab has an active tsunami research program (NOAA 1993). DOGAMI's goal is to complete coastal mapping by 1996, contingent on funding availability.

Recommendations

Recommendation 1-1

Establish criteria and standards for collecting, reporting, and mapping information about chronic and catastrophic coastal natural hazards. Give special attention to classifying hazard areas, particularly to the definition of "high-hazard areas" referred to elsewhere in these policy recommendations.

a. For chronic hazards, base criteria and standards on two CZM Section 309 projects being conducted by DOGAMI and DLCD: (1) all-hazards mapping pilot project and (2) standards for the content of geotechnical reports.

b. For catastrophic hazards, base criteria and standards on the CZM Section 309 catastrophic hazards pilot mapping project and on the tsunami hazard mapping projects referred to above.

c. Require that these criteria and standards be used by consultants, local governments, state and federal agencies, and others conducting hazard assessments (see also Issue 3 concerning geotechnical reports).

Implementing Actions for Recommendation 1-1

1-1 A. DOGAMI should establish criteria and standards using a workshop process involving scientists and resource managers from private consulting firms, academia, DOGAMI, DLCD, OPRD, OSSPAC, and local governments.

1-1 B. DOGAMI, the Board of Geologists and Engineering Geologists Examiners, and the Board of Engineering Examiners should jointly adopt criteria and standards by administrative rule; if such rule-making authority does not exist, it should be sought from the Oregon State Legislature.

Recommendation 1-2

Inventory and catalog coastal natural hazards studies, maps, digital data (for example, bathymetry and topography), and other information available from city, county, state, federal, university, private, and other sources.

a. Before investing new financial resources in collecting and mapping chronic hazard data, evaluate the utility of existing information and mapping, based on the criteria and standards developed in accordance with Recommendation 1-1. Generally, the kind of detailed information required to design and mitigate hazards or specific private projects should not be done at public expense. Publicly funded mapping should focus on improving long-range planning, identifying areas at risk generally, and helping decide when more detailed reports might be needed for specific development projects.

b. For catastrophic hazards information, evaluate the adequacy of the existing information and the need to collect and map new data. Base this evaluation on the criteria and standards being developed as part of the pilot mapping project.

c. Make the catalog of natural hazard information available through the information system proposed in Recommendation 1-3.

Implementing Actions for Recommendation 1-2

1-2 A. DOGAMI should inventory hazards information and maps, establishing priorities in consultation with DLCD, OPRD, DSL, OEM, OSSPAC, and other relevant state agencies; coastal cities, counties, emergency management offices, ports and other special districts; FEMA, the Corps of Engineers, and other relevant federal agencies; and academia.

1-2 B. The OSU Hatfield Marine Science Center (HMSC) Library, in cooperation with DOGAMI, should develop a special collection on coastal natural hazards, including an easily accessible database of available information.

1-2 C. DOGAMI and HMSC should seek funding for the collection, inventory, and cataloging of natural hazard information, and for creating a way for users to access that information. Possible funding sources are DLCD, through the Oregon Coastal Management Program, FEMA, and other state or federal agency sources.

Recommendation 1-3

Develop standardized coastal hazard maps for priority areas along the Oregon coast at a scale of 1:4,800 (1" = 400') or larger.

a. Chronic hazards maps should contain information on the historic and potential wave attack, erosion, flooding, or accretion (potential should be based on wave run-up calculations and assessment of rip current vulnerability); mass wasting (landslides, slumping, weathering) and slope stability (lithologic units [rock and surface deposit types and composition], unit structure [jointing, bedding planes, etc.], and interrelationships [stratigraphy, nature of contacts]); and human activities (foot and vehicular traffic, cliff carving and graffiti, adjacent development or other human alteration). These maps should be used principally to improve planning, to identify general areas at risk, and to decide when to require more detailed reports, but *not* for site-specific decision making. They should be produced with available information to the extent possible and supplemented by additional field work as needed. With no regard to order listed, priority chronic hazard mapping areas are

1) relatively undeveloped areas under development pressure

2) developed areas with a history of chronic hazards and property loss

3) developed areas where improved mapping and data would alleviate persistent conflicts between development and shore protection

b. Catastrophic hazards maps should include the potential for amplified ground shaking, fault rupture, landslides, or other ground failure; soil liquefaction; land subsidence; and tsunami inundation and run-up. Use the maps for disaster response and evacuation planning and for help in determining when site-specific reports on vulnerability to seismic hazards are required by Oregon Revised Statutes (ORS) 455. Produce catastrophic hazard maps with available information and, to the extent possible, supplement them with additional field work as needed. Priority areas for catastrophic hazard mapping include at least the following:

1) low-lying areas with significant population that may be affected by locally generated tsunamis, including coastal ports and harbors, other river mouths, diked lands bordering bays and estuaries, and low dune lands

2) other areas that are particularly vulnerable to the full range of earthquake hazards and where large numbers of people congregate (cities, towns, resorts, schools, shopping and tourist centers, parks, etc.)

c. Do not use public funds for site-specific coastal hazards investigations that are highly sophisticated or field work intensive unless the public benefits of such investigations clearly outweigh the costs.

d. Project applicants should fund site-specific geotechnical investigations prepared in support of development or shore protection proposals (see Issue 3 concerning geotechnical reports).

Implementing Action for Recommendation 1-3

1-3. Using funds appropriated by the Oregon state legislature, and from federal, local, other state, and private sources, and following criteria developed according to Recommendation 1-1 above, DOGAMI should collect data and prepare improved, standards-based chronic and catastrophic hazards maps for priority coastal areas and publish and distribute such information.

Recommendation 1-4

Fund basic and applied research on chronic coastal natural hazards following these general priorities:

a. alternative shore protection methods and their effectiveness

b. design, engineering, and individual and cumulative effects of hard shore protection structures

c. nearshore circulation processes and sediment budgets

d. sea cliff erosion processes

e. other chronic coastal hazards and processes

Implementing Action for Recommendation 1-4

1-4. With DOGAMI coordinating, state, federal, and local agencies, academia, and private organizations should pursue funding for and conduct basic and applied research. Support should be provided based on the above priorities.

Recommendation 1-5

Continue to fund both basic and applied research on earthquake and tsunami hazards and hazards mitigation, including the following:

a. description and mapping of past earthquake and tsunami events and modelling of future events in priority areas (see Recommendation 1-3b)

b. other coastal research needs as outlined in OSSPAC's report to the 1993 Oregon State Legislature (OSSPAC 1992), including geodetic studies, active fault mapping, establishing a strategic seismic network, earthquake-induced landslide studies, and tsunami run-up studies

Implementing Action for Recommendation 1-5

1-5. With DOGAMI coordinating, state, federal, and local agencies, academia, and private organizations should pursue funding for and conduct basic and applied earthquake and tsunami research.

Issue 2

Geotechnical site reports are inadequate for making decisions on land development and shore protection projects.

Site-specific geotechnical reports, prepared in support of land development projects or shore protection proposals, are especially weak in two areas: assessment of shoreline erosion hazards and evaluation of earthquake and tsunami hazards. Because there are no content standards and review criteria, reports are also inconsistent in content and quality and are sometimes difficult to interpret. These problems with geotechnical site reports may result in inappropriate siting decisions, overreliance on structural shore protection for erosion mitigation, ill-conceived capital expenditures for infrastructure, indirect public subsidies of private development, and potentially, the loss of life and property.

Findings

There are no standardized requirements for site-specific geotechnical evaluation of structures or facilities as they relate to chronic hazards. Local governments generally require site-specific geotechnical reports to support development proposals in hazardous areas. There are a variety of problems with current reports and the process for using them in decision making. Among them are the lack of standardized triggering mechanisms for requiring reports; developers' "shopping around" for favorable reports; inconsistent quality of reports; use of outdated methods for determining historic erosion and for projecting erosion vulnerability; the lack of criteria and standards for what must be included in a report for different types of projects; the need for a more thorough review process for some reports; the lack of clear interpretations of data and technical jargon for nongeologist decision makers; and inadequate qualification or proficiency standards for the geologists, engineering geologists, and engineers who prepare such reports. These problems are equally true for shore protection projects handled at the state level, although such reports are not generally required of applicants. Both geological consultants working in coastal areas and the coastal planners who use such reports also cited these problems.

Nevertheless, these often-deficient site reports are used to make decisions about what is needed to mitigate hazards and protect resources. Consequently, decisions often do not adequately address hazard avoidance (for example, through adequate setbacks and building design), shore protection alternatives and structure design, protection of adjacent property, beach sand supply, public access (particularly along the beach), and long-term issues, such as long-term sea level rise.

Requirements for more detailed site-specific geotechnical reports for construction vulnerable to seismic hazards were established in 1991 and are codified in ORS Chapter 455. The design of essential facilities, hazardous facilities, major structures, or special occupancy structures must be preceded by an evaluation of the soil engineering properties at the building site. Such evaluation must be conducted by an "especially qualified engineer or engineering geologist and may require the services of persons especially qualified in engineering seismology, earthquake geology or geotechnical earthquake engineering." Building code officials can apply these same requirements and standards to other construction as needed. Administrative rules for these reports were issued by the Building Code Division (BCD), effective April 1, 1994.

Recommendations

Recommendation 2-1

Establish improved procedures for geotechnical site reports for coastal land development and shore protection projects:

a. Develop and require the use of content standards for geotechnical site reports that are designed to improve report consistency, readability, and justification for recommendations. Such standards should also serve as a comprehensive guide from which appropriate subjects might be investigated at

Some Important Statue-based Definitions

Oregon Senate Bill 96 (1991) Section 12 amended ORS 455 to require site specific evaluation of essential facilities, hazardous facilities, major structures, and special occupancy structures for vulnerability to seismic hazards. Definitions of these terms, used throughout this report, are quoted from ORS 455.447:

(a) **Essential facility** means: (A)Hospitals and other medical facilities having surgery and emergency treatment areas; (B) Fire and police stations; (C) Tanks or other structures containing, housing or supporting water or fire-suppression materials or equipment required for the protection of essential or hazardous facilities or special occupancy structures; (D) Emergency vehicle shelters and garages; (E) Structures and equipment in emergency-preparedness centers; (F) Standby power generating equipment for essential facilities and; (G) Structures and equipment in government communication centers and other facilities required for emergency response.

(b) **Hazardous facility** means structures housing, supporting, or containing sufficient quantities of toxic or explosive substances to be of danger to the safety of the public if released.

(c) **Major structure** means a building over six stories with an aggregate floor area of 60,000 square feet or more, every building over 10 stories in height, and parking structures as determined by agency [Building Code Agency] rule.

(d) **Seismic hazard** means a geologic condition that is a potential danger to life and property which includes but is not limited to earthquake, landslide, liquefaction, tsunami flooding, fault displacement, and subsidence.

(e) **Special occupancy structure** means: (A) Covered structures whose primary occupancy is public assembly with a capacity greater than 300 persons; (B) Buildings for every public, private, or parochial school through the secondary level or day care centers with a capacity greater than 250 individuals; (C) Buildings for colleges or adult education schools with a capacity of greater than 500 persons; (D) Medical facilities with 50 or more resident, incapacitated patients not included in subparagraphs (A) or (C) of this paragraph; (E) Jails and detention facilities; and (F) All structures and occupancies with a capacity greater than 5000 persons.

particular levels of detail, depending on the nature and location of the site and the type and intensity of the proposed project.

b. Establish a list of "triggering mechanisms" that will initiate the geotechnical site report process, and determine the appropriate topics to be covered and level of detail for each. Possible triggering mechanisms are a particular project type or land use, the dollar value of investment required for a particular project, the location with respect to natural hazard zones, or the discretion of the local government.

c. Require that all geotechnical reports, whether supporting or opposing a particular project, be disclosed and made part of the public record at the local level. Also require that their location and availability be made known to potential users.

d. Require that geotechnical site reports, developed under approved content standard guidelines, be valid for a maximum of 10 years, after which an updated or new report would be required.

e. For geotechnical site reports prepared to support applications for shore protection permits, require peer review by qualified professionals at DOGAMI (see Recommendation 6-2b). If a local development permit is required, require that the local and state peer reviews be concurrent.

f. For geotechnical site reports prepared to support development regulated by local government, require peer review by a qualified professional, with the project applicant bearing the cost of review. The triggering mechanism for peer review might be a particular project type or land use, the dollar value of investment required for a particular project, the location with respect to natural hazard zones, or the judgement of the local government. The local process for preparing a geotechnical report and initiating the peer review might be as follows:

   1) Local government determines if a geotechnical site report is required.

   2) If a report is not required, the applicant proceeds with the regular project application process. If a report is required, the applicant

This subdivision along the oceanfront at Newport received a favorable geotechnical report and was approved by the city. Roads and utilities were installed, but the property began sliding seaward before any houses could be constructed. The engineering geologist involved lost his license (P. Komar photo).

hires a qualified geologist, engineer, or engineering geologist to prepare the report and submits it to the local government.

3) Qualified professionals at DOGAMI or the Board of Examiners, or a qualified contract person, conducts a peer review of the geotechnical report.

4) If the report is found to be satisfactory by the peer reviewer, the applicant continues with the regular project application process. If it is not satisfactory, the applicant returns the report to the consultant for additional geotechnical evaluation or analysis, such evaluation is conducted, and the report is submitted once again to the local government.

5) Additional evaluation and analysis continues until a satisfactory geotechnical report is completed and approved or the project is withdrawn.

Implementing Actions for Recommendation 2-1

2-1 A. DOGAMI, in coordination with DLCD, BCD, OSSPAC, OPRD, appropriate professional examining boards, and local governments, should develop and implement administrative rules for the following: (1) standards for the contents of geotechnical site reports, (2) site report triggering mechanisms, (3) public disclosure and filing of site reports, and "sunset" periods, (4) and peer review processes for site reports prepared for state shore protection permit applications. In developing and implementing these rules, DOGAMI should seek authority from the Oregon State Legislature if needed.

2-1 B. Local governments, following state rules and in collaboration with DLCD and DOGAMI, should establish local procedures for geotechnical site reports, including a peer review process for geotechnical reports prepared to support development proposals.

2-1 C. Administrative fees for state shore protection or local development permits requiring geotechnical site reports should include the cost of peer review.

Recommendation 2-2

Improve the licensing process for geologists, engineering geologists, and engineers who work in the coastal zone.

a. Require certification of geologists, engineering geologists, and engineers who prepare geotechnical site reports and recommendations for coastal areas, documenting their qualifications to evaluate coastal processes related to beach, dune, and sea cliff erosion, and to evaluate earthquakes, tsunamis, and related hazards.

b. To maintain coastal certification, require effective continued education or updates specific to the knowledge and skills required for Recommendation 2-1a.

Implementing Actions for Recommendation 2-2

2-2 A. The Oregon State Board of Geology and Engineering Geology Examiners and the Board of Engineering Examiners should develop administrative rules to improve the licensing process for geologists, engineering geologists, and engineers who work in the coastal zone. If necessary, authority should be sought from the legislature.

2-2 B. DOGAMI, in collaboration with appropriate licensing boards and academic continuing education programs, should develop and deliver annual basic coastal certification and update programs for professionals working in coastal areas.

Issue 3

Information about coastal natural hazards is not readily available, nor is it well understood by users and effectively applied in decision making.

Existing information on coastal natural hazards, including academic research, government studies, reports and maps produced for local planning or site development, hazard assessments in permit records, aerial photographs, and other information, is widely dispersed and difficult for most users to access. Further, no means exist to catalog and store new information. As a result, collections of natural hazards data are incomplete, much of the information goes unused after initial application, data collection and mapping efforts are sometimes duplicated, and individuals who could benefit from coastal hazards information do without. Furthermore, many who could benefit from this information do not have the knowledge or skill to apply it.

Findings

Information on coastal hazards that is useful for decision making is widely dispersed and not easily accessible. Special collections that do exist, such as the DOGAMI library, the University of Oregon's Ocean and Coastal Law Library, and other departmental collections at academic institutions, are not physically or electronically accessible to most users. Information available at the local government level or at management agencies is often outdated. Geotechnical site reports prepared for projects are often buried in permit files or remain in the possession of private landowners or consultants. No record is kept of their existence or location. Other potentially useful hazards information developed by government agencies or academia is not widely disseminated, not easily accessible, not in a format or language that is understandable to nontechnical individuals, or simply not available. No single agency is responsible for collecting and making information available or for educating potential users about its existence and potential utility. As a consequence, the same information must be regenerated and decision-making periods lengthened, increasing both the public and private cost of development and shore protection.

Even when information on natural hazards is available, individuals who need to apply it to decision making often do not have the knowledge or skill to do so. For example, public and private professionals working in natural hazards management often do not have appropriate training and are not required to enroll in continuing education. As a result, they sometimes make uninformed decisions. Informal education programs, such as those offered by DOGAMI or OSU's Extension Sea Grant Program, are sporadic and reach only a fraction of those who need them. Information in print and other media is sparse and outdated. Individuals, companies, and organizations involved in land development and property transfer, including the buying public, are a largely overlooked audience for hazards education. Education initiatives aimed at these audiences, combined with regulatory and nonregulatory incentives, could be particularly effective strategies for hazard avoidance and mitigation.

Recommendations

Recommendation 3-1

Establish a coastal hazards information system and repository with several staged components:

a. Establish an ocean shore database in an easily accessible, geographically referenced format, with information organized by land parcel. Applications of this database could include keeping records and reporting permit activity, assessing the initial impact of shore protection proposals, and coordinating agency decision making. The database should contain locational data, environmental and hazard conditions, land use and cultural data, shore protection activity, and permit information. As soon as possible, this

database should be made accessible to the public through the Internet.

b. D evelop a special collection of coastal hazards publications, reports, maps, digital data, and other information useful for coastal hazards research, evaluation, and decision making. Catalog this special collection and make it available to the public through the Internet using Mosaic or a similar easy-access interface. Geotechnical reports prepared to support coastal development or other projects might also be filed and cataloged as part of this collection (see Recommendation 2-1c).

Implementing Actions for Recommendation 3-1

3-1 A. OPRD, in consultation with DLCD, DOGAMI, and local governments, should establish and maintain the ocean shore database, making it available to all users through the Internet.

3-1 B. DOGAMI should inventory and collect hazards information and maps it does not already have. Before doing so, it should establish priorities in consultation with DLCD, OPRD, DSL, OEM, OSSPAC, and other relevant state agencies; coastal cities, counties, emergency management offices, ports and other special districts; FEMA, the Corps of Engineers, and other relevant federal agencies; and academia.

3-1 C. The library at the OSU HMSC should develop a special collection on coastal natural hazards, make it physically available to coastal users, and make it and other information (for example, that from DOGAMI and the Ocean and Coastal Law Center) available through an easily accessible electronic database, including the information developed in the DOGAMI inventory above.

3-1 D. Possible funding mechanisms for collection, inventory, cataloging, and creating user access of natural hazards information are DLCD, through the Oregon Coastal Management Program, and other state agency sources.

Recommendation 3-2

Develop and implement educational programs about coastal natural hazards to increase the knowledge, skills, and effective application of hazards information to decisions. Applicable techniques and media include brochures, displays, videos, workshops, field trips, short courses, technical guides and procedures, and access to electronic databases. Some desired outcomes are better preparation and interpretation of geotechnical site reports; improved personal, business, and public agency decisions related to hazards; and effective preparation for and response to earthquakes and tsunamis (see Issue 16 and Appendix D for details on earthquake- and tsunami-related education needs). Following are the audiences for education about chronic hazards and the specific needs of each audience.

a. The general public: natural hazards and their effects on beaches, dunes, and other shorelands; natural hazard planning and mitigation strategies and programs

b. Oceanfront property owners and prospective owners and their agents (real estate personnel, consultants, architects, contractors, lenders, insurers, etc.): natural hazards affecting beaches and oceanfront properties; land use and shore protection program goals and general and site-specific requirements; appropriate hazard mitigation techniques for different situations; decision-making considerations and standards; available technical assistance

c. Hazard mitigation consultants: land use and shore protection program goals and general and site-specific requirements; content standards for geotechnical reports and appropriate methods for assessing oceanographic and geologic hazards for oceanfront properties, and appropriate hazard mitigation techniques, consistent with requirements of the Statewide Planning Goals and the OPRD regulatory program

d. Local planners and state agency permit administrators, reviewers, and evaluators: natural hazards affecting beaches and oceanfront properties; land use and shore protection program goals and general and site-specific requirements; ways to review and evaluate geotechnical reports that assess oceanographic and geologic hazards for oceanfront properties, and ways to determine appropriate hazard mitigation techniques, consistent with requirements of the

Statewide Planning Goals and the OPRD regulatory program

Implementing Action for Recommendation 3-2

3-2. *Agencies involved in hazard management (FEMA, the U.S. Geological Survey, NOAA, DOGAMI, DLCD, OPRD, local governments, etc.) and state and local educators (universities, community colleges, and outreach programs, such as OSU Extension Sea Grant) should collaborate in the development and delivery of education programs about chronic natural hazards. They should use existing public and private funds for such programs, supplemented by additional initiatives as necessary.*

Issue 4

Hazard disclosure during property transactions is insufficient.

Oregon has only minimal requirements for disclosing information on natural hazards that affect a property at the time of sale or transfer. Consequently, individuals involved in or affected by property transactions are not well informed about the nature and extent of these natural hazards or about the resulting constraints on development.

Findings

Over the years most of the easily developed lots on the Oregon coast have been developed. As a consequence, sites that were once passed over because of their susceptibility to natural hazards are now being developed. Unfortunately, people who want to own and develop coastal property are often unaware of possible coastal natural hazards affecting some coastal sites. Similarly, individuals selling or brokering coastal property are unaware of natural hazards that might decrease the value of their property.

The recent passage of Oregon Senate Bill 1095 (1993) was a first step in requiring some form of disclosure in real estate transactions. However, this law has so many exceptions that it will likely apply only to a small fraction of property transactions. Furthermore, natural hazards disclosure requirements in the new law are incomplete because property owners have the option to disclaim all knowledge of hazards or other potential defects.

Information on natural hazards affecting a property is not readily available to prospective buyers (J. Good photo).

Recommendations

Recommendation 4-1

Revise the real estate disclosure form in ORS 696 to require that all known or potential natural hazards affecting a property be disclosed by all sellers (the owner or the owner's agent) to all potential buyers before a property transaction is finalized. This proposal would remove exemptions from the disclosure requirement but would not eliminate the option for sellers to file a disclaimer in lieu of filling out the disclosure form. Specifically, natural hazards issues now covered in disclosure form section 8 (General) should be deleted and a new category called "Geotechnical" established. Questions under this new category should include the following:

a. Is the property or any portion of it within a designated hazard area or zone, including floodway, floodplain, land slide or slump area, groundwater or drainage hazard area, erosion or accretion hazard area, dune hazard area, or earthquake-related hazard area (amplified ground shaking, soil liquefaction, fault zone, landslide potential, tsunami inundation)?

b. Is the property or a portion of it subject to special zoning or other land use requirements for development that are related to the above hazards (for example, hazard overlay ordinance or geotechnical report requirements prior to site development)?

c. Are all structures on the property built to current earthquake building code standards (zone 3)? If not, to what seismic zone standard are they constructed and in what year did the construction occur?

d. To your knowledge, has there ever been a geotechnical report prepared for this property to address the hazards listed in 4-1a above?

e. To your knowledge, is there a record of any past hazard-related damage to the land or improvements caused by the hazards in 4-1a above or by wind or rain?

Implementing Action for Recommendation 4-1

4-1. OSSPAC should propose state legislation that amends ORS 696 to require complete hazard disclosure according to Recommendation 4-1.

Recommendation 4-2

Establish and maintain a database that includes all known information on natural hazards affecting real property, and make this database available to the public so that it can be determined if a property is located in a hazardous area (see Recommendation 3-1 for implementation).

Recommendation 4-3

Prepare and make available to prospective buyers of potentially hazardous coastal property a "buyer's guide" or hazards evaluation checklist. In the guide, include information on how to access additional information or contacts (for example, through the database in Recommendation 4-2).

Implementing Action for Recommendation 4-3

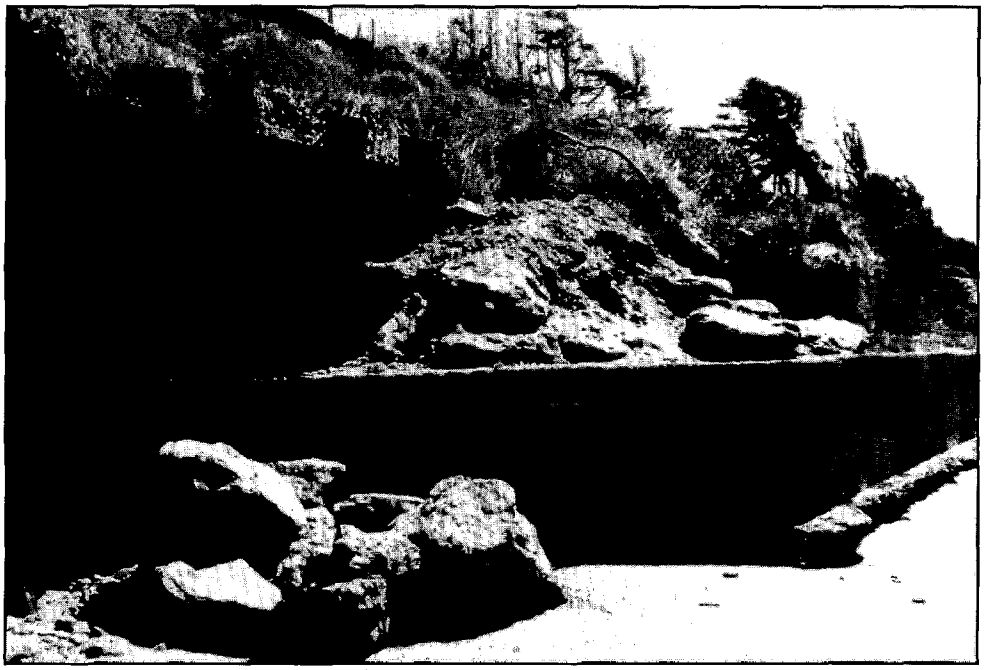
4-3. The OSU Extension Sea Grant Program, in collaboration with the Oregon Board of Realtors, lenders and insurers, DLCD, DOGAMI, local governments, and other relevant agencies, should prepare such a publication as part of its natural hazards education program.

Beach and Shore Protection Procedures

Over the last few decades, population growth and accompanying development have increased dramatically along the Oregon coast. Much of this growth has occurred in hazardous, low-lying beachfront areas and along erodible sea cliffs. New houses, motels, and condominiums and earlier development are increasingly threatened by gradual erosion, bluff slumping, and other hazards. The response to these hazards has generally been to construct SPSs—riprap revetments, seawalls, bulkheads—that are designed to fend off waves, stabilize cliffs, and retain the shoreland (figure 5). Permits for these structures, required by several agencies, are generally approved because of pressure from concerned property owners and because few alternatives seem to be available. As more development occurs adjacent to the beach, normal episodes of erosion create a demand for more and more SPSs.

Continued development pressure along the coast and the proliferation of SPSs have raised questions about the effectiveness of Oregon's shoreline development and shore protection policies and decision-making procedures. Four such issues are addressed in this section, with recommendations for each:

- lack of clear, consistent state policies for shore protection generally, and hard SPSs in particular
- gaps and overlaps in regulatory jurisdiction and interagency review and coordination
- inadequate procedures and standards for permit application review and decision making
- the ad hoc, inconsistent process for emergency shore protection.



A new timber-pile retaining wall (left) and old concrete-reinforced seawall (right) at Arch Cape on the northern Oregon coast (J. Good photo).

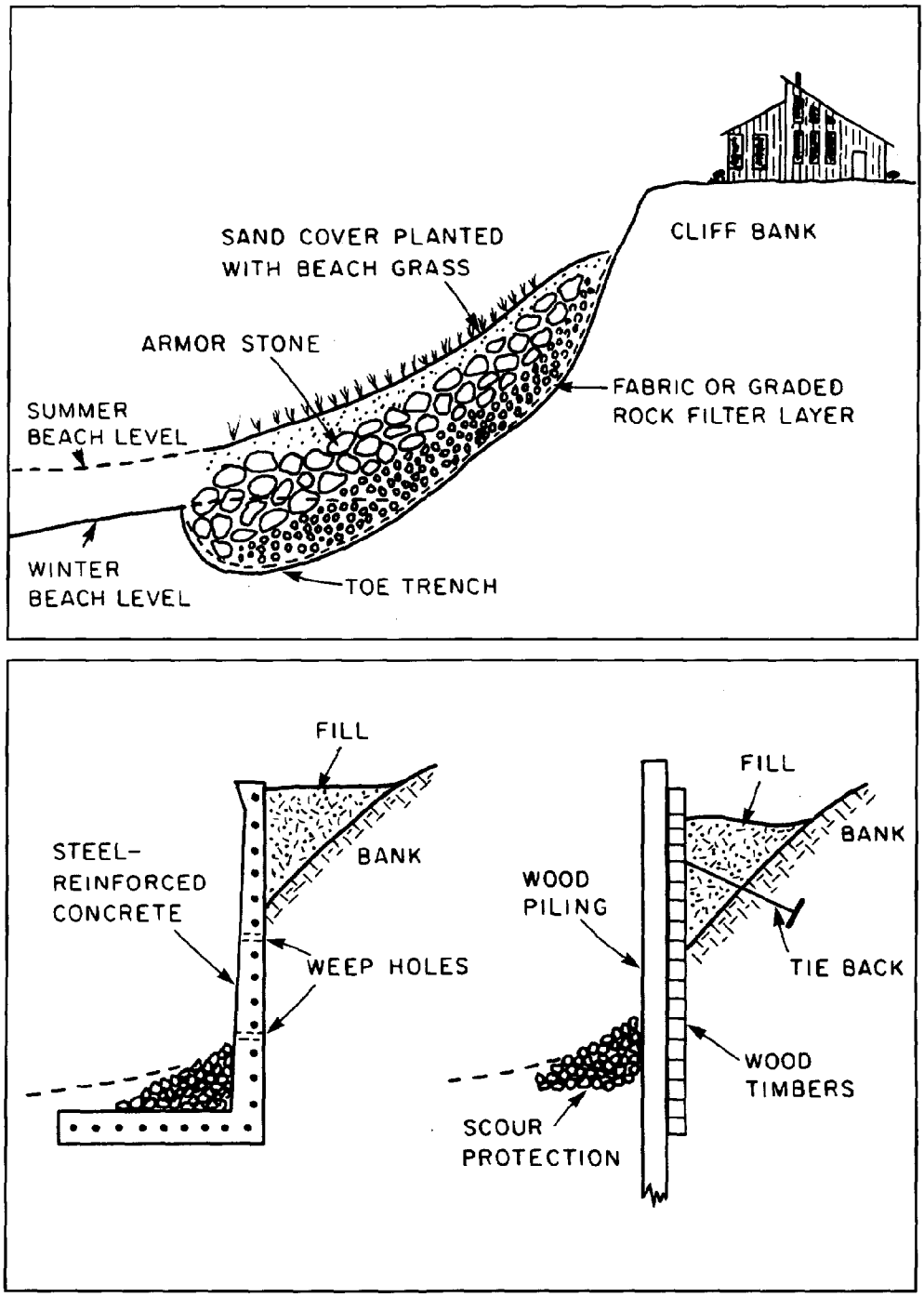


Figure 5.—Design characteristics typical of riprap revetments (above) and seawalls (below) along the Oregon coast.

Issue 5

Goals and policies for shore protection are inconsistent and outdated, particularly with regard to hard structures.

State goals and policies for shore protection, spread among a variety of statutes and administrative rules, are inconsistent, incomplete, and sometimes outdated. One result is an overdependence on hard SPSs to solve problems of erosion and mass wasting to the exclusion of less-damaging methods. These hard structures may have significant, adverse, short-term impacts and long-term cumulative effects on beaches and adjacent shorelands.

Findings

Oregon's shore protection program consists of a variety of state and local policies and regulatory programs designed principally to protect the recreational values and uses of the beach and the integrity of adjacent shoreland property. These programs, described earlier in this report (table 1), were created at different times and for somewhat different, but interrelated purposes. Consequently, many of the policies are outdated or incomplete with respect to beach processes, coastal hazards, and hazard mitigation strategies. They are also inconsistent, often suggesting opposite courses of action for the same project. Overarching goals and policies guiding shore protection are needed, particularly with respect to hard shore protection structures that fix the shoreline in place. The proliferation of these hard shore protection structures along some parts of the coast has raised concerns about their adverse short-term and cumulative effects on beaches and adjacent shorelands.

Much of the scientific and engineering research on the effects of hard structures, including seawalls, revetments, groins, and jetties, has focused on physical impacts, such as acceleration of erosion in front of and adjacent to the structure, loss of sand supply, and gradual loss of beach sand volume and width. However, there may be other impacts as well, including blockage of public access to the beach or of escape access from the beach during high tides or waves and loss of biological habitat or resources, including threatened or endangered species (for example, snowy plover). Hard structures also detract from the natural beauty of the shoreline and the beach recreational experience.

Kraus (1988) reviewed about 100 technical papers on the effects of seawalls on beaches, concluding that beach change near seawalls, both in magnitude and variation, is similar to that on beaches without seawalls, *if* a sediment supply exists. However, on beaches with seawalls, the form of erosional response is different, with toe scour and flanking effects common. Laboratory studies conducted by Komar and McDougal (1988) quantified this effect, but their field studies along the Oregon coast have been inconclusive because few storms have affected monitored structures during the study period.

Other field studies by Griggs and Tait (1988) along the central California coast found that seawalls and revetments cause excess winter scour in front of and at the ends of the structures. The researchers believed this resulted from a combination of wave reflection and sand impoundment upcoast. Pilkey and Wright (1988) compared the dry beach width of a number of protected and unprotected beaches on the east coast. They found that dry sand widths in front of seawalls is consistently and significantly narrower than beach width along unprotected shores. They point out that beach destruction may take place over several decades and that the study of single events or short-term changes may be of limited value in understanding the effects of seawalls. Another aspect of the debate over the effects of hard SPSs has to do with cause and effect relationships (Weggel 1988; Kraus 1988). Do SPSs exacerbate erosion, or is it simply that beaches with chronic erosion problems attract SPSs? Terich and Schwartz (1990), in their literature review of the subject, conclude that while more SPSs may be installed on chronically eroding beaches, the preponderance of evidence suggests that seawalls do accelerate erosion of nearby beaches and adjacent properties.

Riprap revetments often extend out onto the public beach, as illustrated here at Gleneden Beach (J. Good photo).

There has been no systematic examination of the effectiveness of hard structures along the Oregon coast. At the same time, nonstructural shore protection options often seem limited because there is little information available about alternative protection methods and their feasibility along the Oregon coast.

Recommendations

Recommendation 5-1

Establish clear, consistent goals and policies for operating the beach and shore protection program administered by OPRD under the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas). Recommended goals for the program are to

a. protect, and where appropriate, restore the beach and its natural resources for public use and enjoyment in perpetuity

b. protect human life and property from natural hazards, giving priority to mitigation alternatives that avoid hazards or use nonstructural techniques (see table 3 for examples)

c. conserve, protect, and where appropriate, develop or restore oceanfront shorelands consistent with 5-1a and 5-1b above.

Implementing Action for Recomendation 5-1

5-1. The Oregon State Legislature should amend the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas) to establish specific goals and policies for regulating beachfront and ocean shore alterations, consistent with Recommendation 5-1.

Recommendation 5-2

Strongly discourage hard SPSs that fix the shoreline in place and interfere with the physical processes of the natural beach and shoreland. As a first-level guide, classify oceanfront shorelands as follows for making decisions about shore protection:

a. For "undeveloped" oceanfront property, do not allow hard SPSs in any case. Undeveloped shorelines are defined in Statewide Planning Goal 18, Beaches and Dunes (LCDC 1990), as vacant parcels of oceanfront shorelands that lacked physical improvements, such as streets and utilities, as of January 1, 1977.

b. For "infill" oceanfront property, do not allow hard SPSs unless applicants can provide clear and compelling evidence that hazard avoidance and other less damaging nonstructural shore protection methods are not feasible. Infill properties are vacant parcels-usually small to moderate sized-that are committed to development because of existing roads, utilities, and other improvements.

c. For "developed" oceanfront property, allow hard SPSs, but only if applicants can demonstrate that hazard avoidance and other less damaging nonstructural shore protection methods are not feasible. Developed parcels are those that contain a permanent structure or building and are serviced by streets, utilities, and other improvements.

Implementing Action for Recommendation 5-2

5-2. The Oregon State Legislature should amend the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas) to limit use of hard shore protection structures consistent with Recommendation 5-2. OPRD should develop appropriate administrative rules to implement these provisions.

Recommendation 5-3

Conduct a thorough review of studies of alternative shore protection techniques throughout the U.S. and the world. Test and evaluate promising alternatives to revetments, seawalls, and other hard shore protection structures; some alternatives are dune construction, vegetative stabilization, and beach nourishment (table 3). The feasibility of dynamic revetments, which are composed of movable gravel- and cobble-sized materials placed on the backshore, should also be investigated (Ahrens and Heimbaugh 1989; Lorang 1991).

Implementing Action for Recommendation 5-3

5-3. OPRD, DOGAMI, and DLCD, in cooperation with the U.S. Army Corps of Engineers (USACOE) and coastal local governments, should establish a program to systematically evaluate alternatives to hard shore protection structures, using state or federal property or voluntary, privately owned property as test sites. Test results should be incorporated into the evaluation of shore protection permit applications.

Table 3. Land use management and non-structural alternatives to hard shore protection structures.

Alternative or Method	Description	Applicability	Information Sources
Construction setback	Horizontal setback from shoreline based on beach type, upland landform and erosion resistance, elevation. long-term erosion or recession rate, susceptibility to episodic erosion, relative sea level rise, relocation factor, etc.	Feasible for new or relocated construction where lot is sufficiently deep and topography relatively flat	Godschalk et al. 191989 Houlahan 1989 Keillor and Miller 1987 National Research Council 1990
Building design	Proper foundation, infiltration & drainage controls, roof design, building materials, utility location, etc. with respect to wind force, maximum storm surge and wave setup & run-up, flooding, landslide potential, earthquake shaking, liquefaction, and subsidence	Feasible for all new and remodelled construction; varies based on hazards and landform	Collier Undated Godschalk et al. 1989 Pilkey et al. 1983
Relocation	Moving existing upland buildings landward, on-site or off-site	Feasible on level, deep lots or where another site available; applicable to existing development or remodels	National Research Council 1990 USACOE 1981 Griggs 1986
Infiltration/drainage controls	Prevention of water from entering ground or removal of existing water from ground to improve slope stability; uses collectors, drains, wells, dewatering pumps, outlets.	Feasible for new and existing sites and buildings; applicable principally on high and/or stratified bluffs	Herdendorf 1984 Keillor 1986 Tainter 1982 USACOE 1981
Dune creation & restoration	Placement of mound or sand seaward of existing shorelands fronted by beaches; stabilized by sand fences and vegetation	Useful as buffer against upland erosion; most effective in episodic (not chronic) erosion situation; not very resistant to direct wave attack; more effective in combination with "soft" structure core and vegetative stabilization	Broome et al. 1982 Jacobsen 1988 Mauriello 1989 McLaughlin and Brown 1942 Ternyik 1979 USACOE 1984 Carlson et al. 1991

Continued on next page

Table 3—*Continued*

Alternative or Method	Description	Applicability	Information Sources
Vegetative stabilization	Use of native and exotic vegetation to stabilize soil or sand along the shorefront or on dunes	Feasible on bluff slopes >1:1.25 where there is some soil development and where roots can penetrate; and on dunes or bare sand; not effective in stabilizing toe of bluff or dune susceptible to direct wave or wave swash attack	Herdendorf 1984 Jacobsen 1988 McLaughlin and Brown 1942 Tainter 1982 Ternyik 1979 USACOE 1981 USACOE 1984 Carlson et al. 1991
Bank/bluff sloping	Creation of a stable slope angle by placement of material at the toe (e.g., dune creation), and/or regrading the slope	Feasible for some over-steepened bluff slopes, especially in combination with infiltration and drainage control, vegetative plantings, and dune creation at base (or other toe protection)	Herdendorf 1984 Keillor 1986 Tainter 1982 USACOE 1981
Beach fill/nourishment	Placement of substantial quantities of beach-compatible sand to advance the shoreline seaward	Applicable to important recreational beaches where there is ready compatible sand source and reasonable expectation of nourished beach stability; expensive alternative; not used in Oregon	Chisholm 1990 Clayton 1989 Dean 1983 Dixon and Pilkey 1989 Domurat 1987 National Research Council 1987 USACOE 1981 USACOE 1984

Issue 6

There are gaps and overlaps in shore protection regulatory jurisdiction and in the interagency review and decision-making process.

There are geographic gaps in regulatory jurisdiction over SPS installation that result in SPSs being built in some areas without public oversight, evaluation, or permits. There are also jurisdictional overlaps of regulatory authority, resulting in duplication of efforts, public frustration, and added public and private costs. The present interagency review process for permits is also inconsistent and does not involve all agencies with relevant responsibilities or expertise.

Findings

OPRD and DSL, the two state agencies that regulate SPSs, differ in what they regulate and where they have jurisdiction (figure 6 and table 4). Specifically, OPRD regulates only beach alterations (any type of structure or material) that extend west of a fixed line called the beach zone line. The beach zone line, established by survey in 1967, approximated the vegetation line or the 16-foot elevation (referenced to National Geodetic Vertical Datum of 1929 or mean sea level) (table 4 and figure 6). DSL, on the other hand, regulates all structures that involve 50 cubic yards or more of material and that are installed seaward of the highest measured tide (about 8.5 feet referenced to mean sea level [DSL 1973]) or the line of established upland vegetation, whichever is further inland (figure 6 and table 4). The consequence of such gaps was illustrated in a recent study of the Siletz littoral cell (encompassing Lincoln City, Gleneden Beach, etc.), where 31 percent of oceanfront SPSs built from 1967 to 1991 did not come under the regulatory jurisdiction of the programs; that is, no permit was required by the state (Good 1992). Some of these gaps were closed when DSL assumed joint jurisdiction in 1977, but some remain.

These gaps in jurisdiction mean that significant numbers of SPSs may be built in the future without state oversight. In such cases, there will be no evaluation to ensure that (1) there is a clear need for the project; (2) less damaging alternatives have been evaluated and judged not to be feasible; (3) the design of the structure is appropriate to the hazard; and (4) site-specific and cumulative impacts are evaluated and avoided or minimized.

Overlapping permit authority and jurisdiction is also a problem. At present, property owners may be required to get permits from four separate agencies to obtain permission to build a beachfront SPS in Oregon (table 4): city or county government, two state agencies—OPRD and DSL—and the U.S. Army Corps of Engineers. City and county requirements are highly variable; some jurisdictions require separate SPS permits that operate independently of the state process and duplicate it, while others defer to the state. However, all have local comprehensive plan policies that must be complied with. At the state level, OPRD and DSL jurisdictions overlap in the majority of cases. A recent study of the Siletz littoral cell, a 16-mile stretch of coastline that includes Roads End, Lincoln City, Salishan, and Gleneden and Lincoln Beaches, revealed that 63 percent of the SPS permits processed since 1977 were processed by both agencies. At the federal level, the U.S. Army Corps of Engineers has regulatory authority for SPSs along Oregon's beachfront. In most cases, however, shore protection proposals are automatically approved because they fall under the Corps' nationwide authorization for bank stabilization projects (Nationwide Permit 13) or under their more specific regional permit for ocean erosion control. The net effect of this is to delegate Corps authority to OPRD/DSL and the state process.

Proposed ocean shore protection projects, whether structural or nonstructural, involve a number of interrelated decisions, for example, determining the hazard, selecting the appropriate hazard mitigation techniques, and designing the project. Such projects also require an assessment of possible adverse impacts, including cumulative impacts, for example, to the beach, to adjacent property, and to scenic and recreational resources. No single public

agency has all the expertise needed to make all of these decisions or evaluate all of these impacts. At the same time, no single agency has all the responsibility. Therefore, while it is important that one agency have ultimate decision-making authority, the review and evaluation process needs to involve those persons or agencies that have appropriate experience and responsibility. The existing process covers some but not all needed areas of expertise. For example, the oceanographic and geologic hazards associated with ocean shore protection are not reviewed by agencies with experience in that area. The designs of structures are not reviewed according to engineering criteria, and they are not thoroughly evaluated for possible adverse impacts. Another part of the problem is that neither state agency nor local government staff involved in the decision-making process have sufficient training to make well-informed decisions on shore protection.

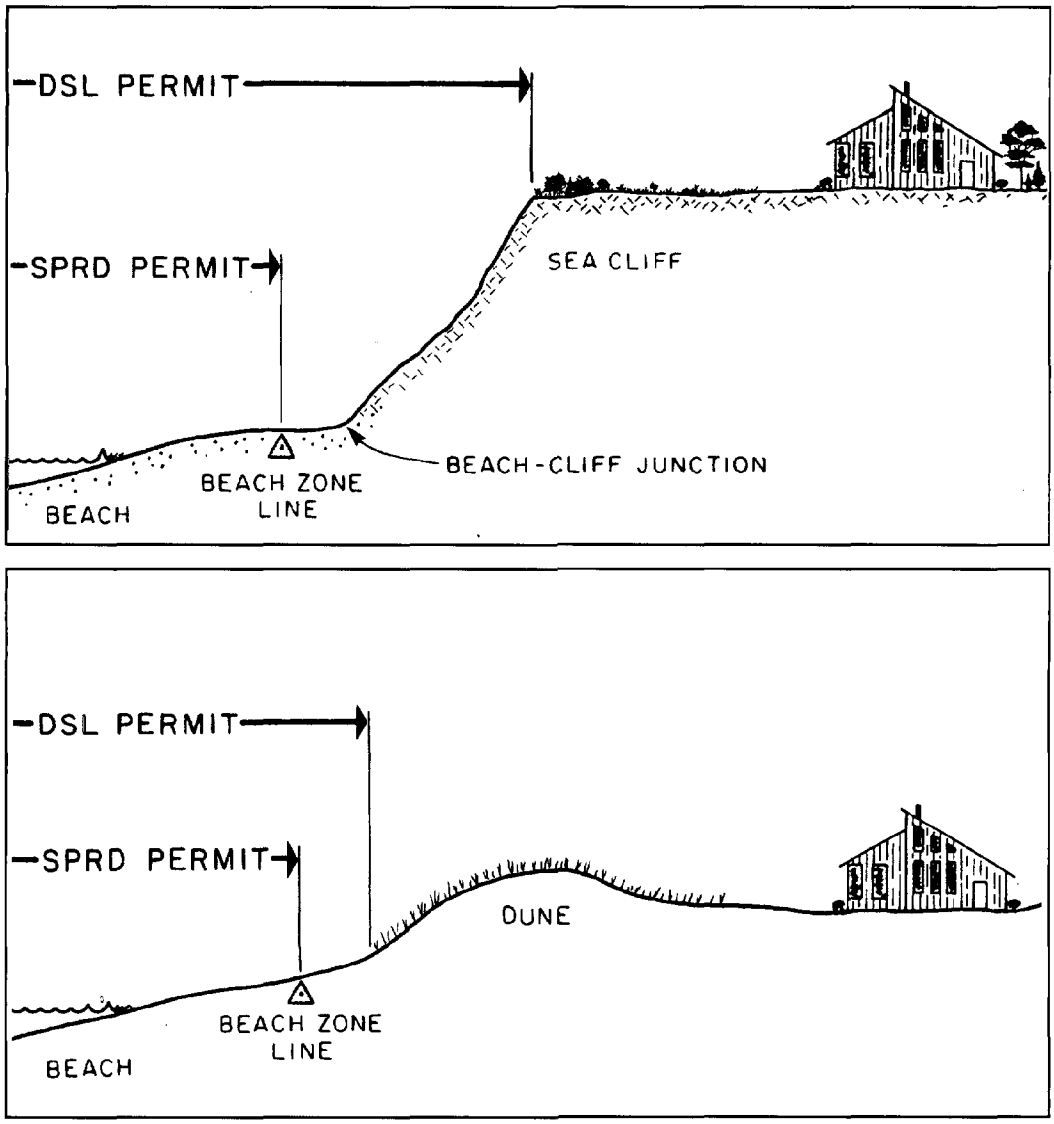


Figure 6.—Geographic comparison of jurisdiction of state regulatory programs for shore protection in Oregon.

Table 4. Jurisdictional comparison of shore protection regulatory programs in Oregon.

Governmental Level/Agency	Type of Permit	Types of SPSs Regulated	Area of Regulatory Jurisdiction	Threshold of Jurisdiction
Federal—Corps of Engineers (COE)	NWP 13 w/regional conditions (new/repair)	Riprap revetments; others if notification procedures followed and impact minimal	Below ordinary high water (OHW)—rivers; or high tide line (HTL)—tidal areas	<500 ft in length and <1/2 cu yd of riprap below OHW or HTL
	Regular (new/repair)	Vertical concrete and other retaining walls, all structures not covered by NWP 13	Same as above	>500 ft in length and >1/2 cu yd of riprap below OHW or HTL
State—Parks and Recreation Department (OPRD)	Regular (new only)	All structure types, including sand or other fill	West of the 1967 surveyed beach zone line (BZL)	None—all improvements covered, but no permit required for repair to original condition
	Emergency (new only)	All structure types (usually riprap revetments)	Same as above	Same as above
State—Division of State Lands (DSL)	Regular (new/repair)	All structure types, including sand or other fill	Line of established upland vegetation or highest measured tide, whichever is highest	>50 cu yd of riprap or other fill (sand, concrete, etc.)
	Emergency (new/repair)	All structural types (usually riprap revetments)	Same as above	Same as above
Local—city or county	Regular (may defer to OPRD/DSL process)	All types, but varies with city/county	Varies, but may include areas landward of state jurisdiction	Varies

Recommendations

Recommendation 6-1

Regulate the installation of all ocean shore protection structures, other activities designed to stabilize or protect the beach or oceanfront property, and other construction on or immediately adjacent to the beach, including repairs of existing structures. Examples of regulated structures and activities are riprap and other revetments, seawalls, and other hard structures that fix the shoreline in place; dynamic structures; beach fill or sand removal, beach nourishment, dune construction, or other sand alteration; sloping, lowering, fencing, or other alteration of oceanfront banks, bluffs, or dunes; vegetative stabilization of oceanfront dunes, cliffs, banks, or bluffs; and other beach construction for any purpose.

Precise jurisdiction should be determined jointly, in advance,[1] by OPRD, DLCD, DOGAMI, and the affected local government, and include the following:

a. all oceanfront beaches along the Oregon coast, including stream and river outlet beaches strongly affected by ocean processes

b. all sand dunes adjacent to beaches (as defined above) that are subject to wave undercutting or overtopping during high tides and severe storms

c. all sea cliffs, bluffs, and banks adjacent to beaches (as defined above)

d. other oceanfront areas potentially subject to severe erosion, accretion, or other chronic hazards

Implementing Actions for Recommendation 6-1

6-1 A. The Oregon State Legislature should amend the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas) to establish new policies and procedures for regulating beachfront and ocean shore alterations, consistent with Recommendation 6-1.

6-1 B. Following legislative changes, the OPRD, in cooperation with DLCD, DOGAMI, and affected local governments, should implement a program to determine precise regulatory jurisdiction, based on the criteria in Recommendation 6-1.

Recommendation 6-2

Place exclusively under OPRD's control both regulatory permit administration and decision-making authority for ocean shore protection structures and activities.[2] No other state agency or local government should be allowed to require a separate permit for SPSs and activities. Minimize administrative costs by establishing an OPRD-coordinated permit review and evaluation process. Base the review and evaluation responsibilities of state agencies and local governments on the legal authority and expertise of each agency. These responsibilities include the following:

a. OPRD: serve as lead shore protection agency and final decision-making authority; evaluate shore protection proposals for their potential effects on beach recreation, scenic and aesthetic issues, public access to and along the beach, public safety, and cultural resources

b. DOGAMI: assess the factors affecting shoreline stability and proposed mitigation strategies, including design and engineering; review and evaluate permit documentation or conduct peer review of consultant reports that include similar information (see Recommendation 2-1e)

c. DLCD: evaluate shore protection proposals for consistency with state land use goals and policies and the state permit consistency rules

d. DSL: evaluate proposals for conflicts with state proprietary interests in tidelands, and public trust interests in navigation, commerce, fishing, and recreation

[1] The shore protection regulatory boundary should be established in advance to make it clear to the regulated public; however, until such boundary is mapped, it should be determined on a case-by-case basis. Shore protection jurisdictional boundaries should be reviewed and updated, as appropriate, every five years.

[2] As an interim measure, OPRD and DSL have executed a Memorandum of Understanding implementing, to the degree possible under current law, consolidation of permit responsibilities with OPRD.

e. ODFW: evaluate shore protection proposals for impacts on fisheries and wildlife

f. DEQ: evaluate proposals for water quality effects and provide certification if applicable

g. Cities and counties: evaluate shore protection proposals for compatibility with the local comprehensive plan and state permit consistency, retaining veto power for inconsistent projects. Such review shall not be considered a land use decision and is not subject to separate local appeals or hearings (all such appeals and hearings shall instead be part of the state permit decision-making process).

Implementing Actions for Recommendation 6-2

6-2 A. The Oregon State Legislature should amend both the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas) and the Removal/Fill Law (ORS 196.800-196.990), vesting sole regulatory authority for beachfront and ocean shore alterations with OPRD, eliminating DSL's separate regulatory authority for such decisions, and establishing review and advisory roles for DOGAMI, DLCD, DSL, ODFW, DEQ, and cities and counties consistent with Recommendation 6-2.

6-2 B. The Oregon State Legislature should authorize and the OPRD should establish an equitable administrative fee that covers the cost of administering the shore protection regulatory program, including costs of the principal review agencies, particularly DOGAMI.

Issue 7

The shore protection permit process is poorly structured, and has weak review standards and limited enforcement authority, and the appeals process is antiquated.

The process for receipt, review, and technical evaluation of shore protection applications lacks sufficient structure and review standards, resulting in inconsistent decisions. OPRD lacks enforcement authority, and the appeals process is out-of-date and overly expensive and time consuming.

Findings

State and local shore protection policies in the Statewide Planning Goals, local comprehensive plans, the Beach Law, the Removal/Fill Law, and OPRD and DSL administrative rules imply a step-by-step decision-making process and various review criteria and standards. However, this process and these criteria and standards have not been fully and consciously implemented. The implied process includes the following general steps: (1) assessing the hazard and determining the threat or need; (2) evaluating alternative hazard mitigation measures while giving preference to nonstructural and land use management methods over structural methods; (3) evaluating potential adverse impacts associated with each feasible technique; (4) designing shore protection solutions that minimize individual project and long-term cumulative impacts, including compensatory mitigation. These steps suggest the need for decision-making support tools and information. They include a hazard assessment model; criteria to decide what hazard poses sufficient threat or need; a set of alternative nonstructural and structural techniques that may work in given situations; a checklist for impact assessment and more detailed guidelines where needed; and engineering and design guidelines. Finally, once a decision is made, weak enforcement procedures and penalties provide little incentive for compliance.

Another process-related issue is that the circuit court appeal procedure is antiquated, costly, and inefficient. Currently, all other state natural resource agencies with permit jurisdiction operate using the contested case hearing process. This process was established in 1973 in the Administrative Practices Act, eight years after the Beach Bill was passed. It is costly for an applicant to hire an attorney and pay court costs when appealing to circuit court. It is also costly to the state to provide legal representation and costs. Finally, circuit court workloads can unnecessarily delay a decision for up to several years, causing frustration for all parties involved.

Recommendations

Recommendation 7-1

Establish a coordinated process for making decisions on shore protection proposals. The process should include an evaluation of hazards and threats to property, alternative mitigation techniques and designs, impacts of alternatives, and compensation needs. To determine the least damaging, effective shore protection method, include the following sequence of steps in the evaluation process:

Step 1. Assess hazards affecting the property, including the following:

a. wave attack, erosion, flooding, or accretion history; wave attack, erosion, flooding, or accretion potential, based on wave run-up calculations and assessment of rip current potential

b. mass wasting (landslides, slumping, weathering) and slope stability (lithologic units [rock and surface deposit types and composition], unit structure [jointing, bedding planes, etc.], and interrelationships [stratigraphy, nature of contacts])

c. human activities (foot and vehicular traffic, cliff carving and graffiti, adjacent development, or other human alteration)

Step 2. Determine what property is threatened and the need for shore protection, based on the following:

a. determine permissible shore protection techniques for the particular class or type of property, that is, whether it is developed, infill, or "undeveloped as of January 1, 1977" (see Recommendation 5-2a)

b. an evaluation of the actual hazards as they relate to the physical safeness of a building or infrastructure for its present uses

Step 3. Evaluate alternative hazard mitigation measures (table 3). In solving problems of ocean flooding or erosion, give preference to hazard avoidance and nonstructural methods over structural methods.

a. Hazard avoidance techniques include building construction and infrastructure setbacks, relocation of existing buildings and infrastructure, and abandonment of threatened buildings.

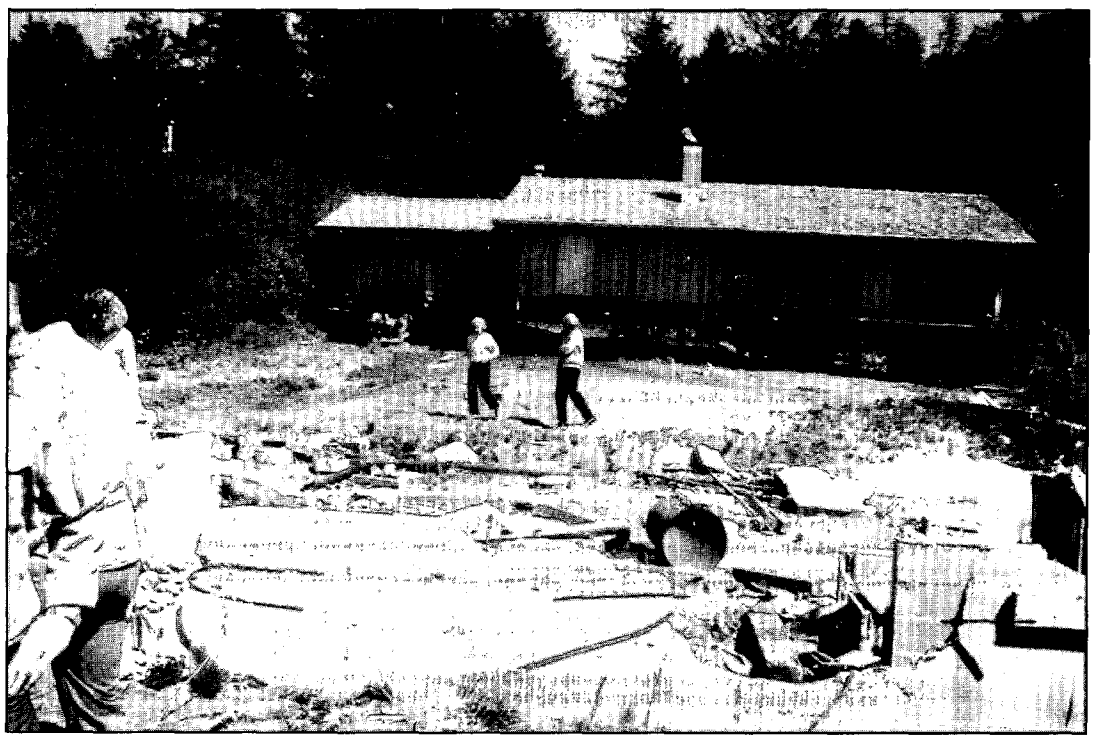
b. Nonstructural shore protection includes vegetative stabilization, preferably with native species, dune construction and other sand alterations, and bank sloping and revegetation.

c. Dynamic revetments, if feasible, are preferred over engineered revetments or seawalls.

Step 4. For each feasible hazard mitigation technique, estimate individual and cumulative impacts on public access and recreation, visual and scenic resources, the beach and adjacent land erosion and sediment supply, public safety, and cultural and natural resource values.

Step 5. From among feasible techniques, select the shore protection solution, including its design and engineering specifications, that balances the need for effective hazard mitigation with the need to minimize adverse impacts.

Step 6. Require compensation for unavoidable, short- or long-term adverse impacts on sand supply, public access and safety, recreational beach use, scenery, wildlife, etc. Examples are contribution to a "sand bank" for beach nourishment, replacement of public access, or funding for such access. Compensation



Relocation of existing buildings threatened by erosion is a viable mitigation strategy in many cases, but is rarely used. This house at Cove Beach in southern Clatsop County is an exception (J. Good photo).

should be directly related to the adverse impact caused by the project.

Implementing Action for Recommendation 7-1

7-1. Oregon State Legislative amendments to the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas) should include the general permit application review and decision-making framework outlined in Recommendation 7-1. OPRD, in cooperation with review agencies, should adopt administrative rules outlining specific procedures for permit application review and evaluation. OPRD should also develop an improved application form for shore protection permits that includes the information needed to implement the process.

Recommendation 7-2

Vest sufficient administrative and civil enforcement authority in OPRD to ensure an effective beachfront and ocean shore regulatory program. Model such authority after DSL's enforcement powers under the Removal/Fill Law (ORS 196.860-990). Change the appeals process so that any person aggrieved by an OPRD permit decision under ORS 390.650 can petition the OPRD director for reconsideration of the final decision. The aggrieved person may also petition the OPRD for a formal contested case hearing, as prescribed in ORS 183.310. The outcome of the hearing should be final.

Implementing Action for Recommendation 7-2

7-2. The Oregon State Legislature should amend the Beach Law (ORS 390.605-390.770, Ocean Shores; State Recreation Areas) to vest enforcement authority in OPRD and revise the appeals process, consistent with Recommendation 7-2.

Issue 8

Emergency shore protection policies and procedures are lacking.

Because emergency shore protection procedures are essentially ad hoc, they result in inconsistent, uncoordinated decisions and violate both the letter and the spirit of other shore protection policies. There are also no guidelines for actions following the emergency, such as site restoration.

Findings

There are no criteria for what constitutes an "emergency" with respect to hazards and threat or need. This situation presents special problems for property that was undeveloped as of January 1, 1977 because of the prohibition on hard SPSs on such property. Alternative permissible methods of emergency shore protection have not been outlined, sometimes resulting in poorly placed or built structures. There is also no policy on what to do with emergency structures once the emergency has passed; at present, they become permanent structures.

Recommendations

Recommendation 8-1. Establish clear, consistent definitions, policies, procedures, and conditions for allowing "emergency" shore protection, beginning with the following:

a. A shore protection "emergency" is a severe, short-term episode of erosion or related hazard that threatens to damage or destroy an upland building, road, street, highway, sewer or water line, or other infrastructure or improvement.

b. OPRD, as lead shore protection agency, should make emergency determinations, consulting with DOGAMI, if needed.

c. Design emergency shore protection actions to provide immediate and temporary protection from an active ocean erosion event or other natural hazard. Such measures may include the following:

   1) dumping riprap or other erosion-resistant material, the size of which is the minimum needed to halt the erosion

   2) grading or placing beach sand

   3) placing sand bags or tubes

   4) moving or placing driftwood

d. Construction of revetments or seawalls or other devices or alterations that provide more than immediate protection from active erosion are inappropriate for emergency shore protection.

e. Require the following standard conditions for emergency shore protection authorizations:

   1) Placement or movement of rock, sand, or driftwood shall be limited to the area immediately seaward of the threatened oceanfront property and be carried out in a manner that does not deflect erosive forces toward adjacent properties or the beaches that front them.

   2) Within one year of their emergency authorization, recipients shall remove all rock or other permanent, erosion-resistant materials used for emergency shore protection and restore any damage to the recreational or scenic values of a beach that are attributed to the emergency measures that were taken. Restoration may include smoothing excavated areas and restoring dunes or beach access points damaged during emergency shore protection activities.

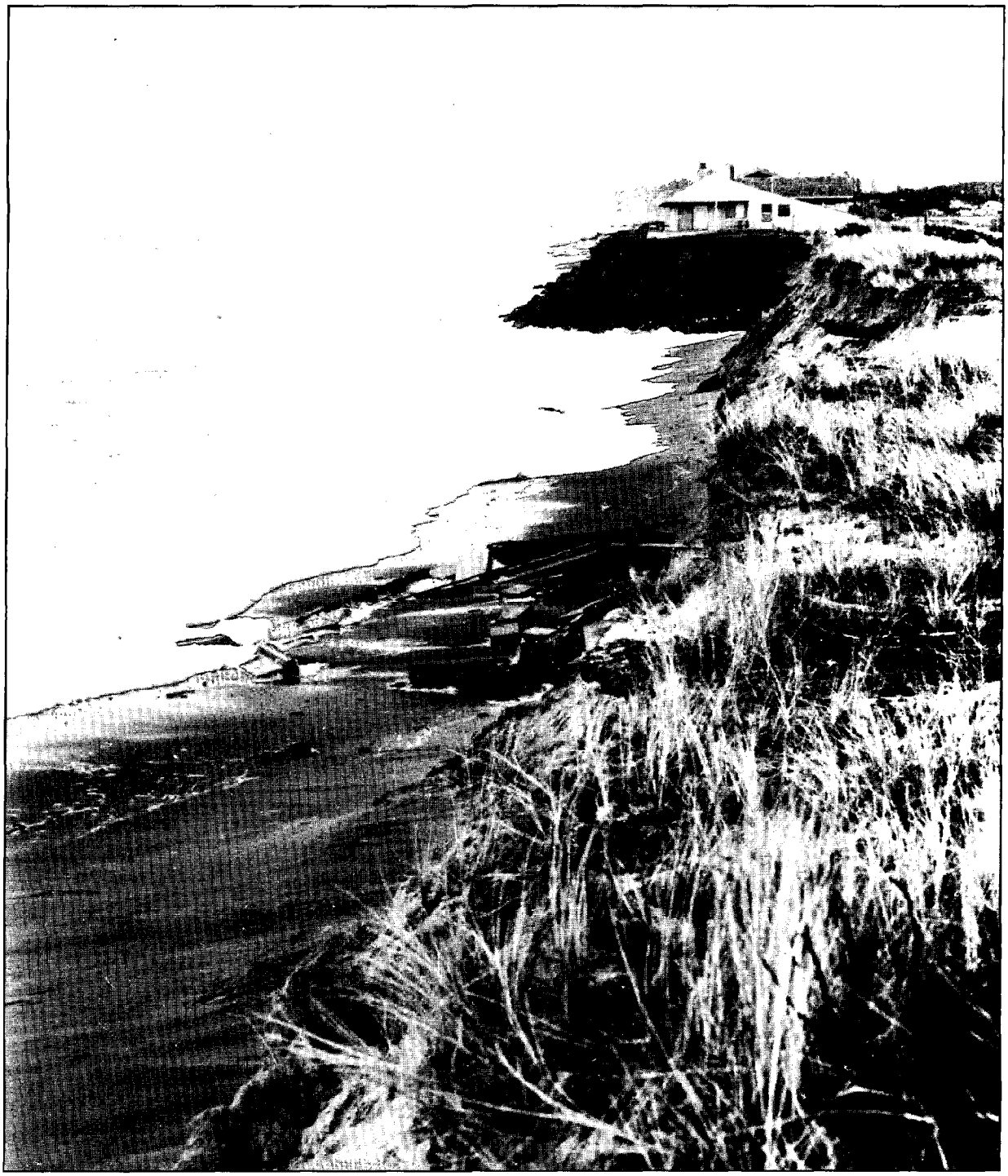
   3) Emergency authorizations for shore protection may not be converted to regular shore protection permits. The regular process for obtaining a shore protection permit is a separate procedure requiring independent evaluation of long-term solutions to erosion or related natural hazard problems.

   4) For properties that were undeveloped as of January 1, 1977," only nonstructural hazard mitigation techniques may be used as long-term solutions to erosion.

Implementing Action for Recommendation 8-1

8-1. The Oregon State Legislature should amend the Beach Law (ORS 390.605-390.770, Ocean

Shores; State Recreation Areas) to establish emergency shore protection policies consistent with Recommendation 8-1. OPRD should implement this emergency process through administrative rules.



Some erosion events clearly create shore protection emergencies, such as this one on Siletz spit (P. Komar photo).

Land Use Planning, Governmental Coordination, and Fiscal Responsibility

The vulnerability of development to natural hazards is an increasingly important concern along the Oregon coast. Part of this concern stems from the acceleration of building construction in recent years, much of it in areas subject to erosion, landslides, and other chronic hazards. But probably a more significant factor is the growing awareness that very large earthquakes have occurred in the past just offshore along the CSZ and that another quake could occur at any time. The likelihood of such an event in the future, despite uncertainty as to its timing, places new and existing development at risk, particularly development on steep slopes, unconsolidated and fill soils, and low-lying ocean and estuary shorelands.

Oregon's land use policies and local comprehensive plans prohibit development in hazardous areas without appropriate safeguards, but implementation of these policies along the coast has not been uniformly effective. As might be expected, given the relatively recent revelations about past coastal earthquakes and tsunamis, few if any local governments have factored the threat of such events into their land use plans or decisions. But more surprising is that development continues to be sited in areas vulnerable to chronic hazards, particularly along the oceanfront. Some problems can be attributed to a lack of state policy guidance on hazards concerns, while others stem from weak local plans or ordinances or poor communication and coordination among agencies with hazard management responsibilities.

Escalating property values are one of the principal forces driving development of many areas subject to natural hazards. Many hazardous sites, particularly along the oceanfront or bayfront, and on steep hillsides, that would be considered unbuildable under normal circumstances, are simply deemed too valuable not to develop. Recent dramatic increases in assessed values and real property prices support this assertion. Because local governments derive much of their revenue from property taxes, they often support such development, regardless of potential hazards. For example, required oceanfront construction setbacks are routinely avoided through variances, which then lead to requests for seawalls or revetments. Another problem is that many of these sites were committed to future development earlier in the century; in many cases these commitments were included in state-approved local comprehensive plans. Further, many property owners believe that they should have the right to do with their land as they please, regardless of the hazards present. For the government to require otherwise would raise the specter of a "taking" of private property without just compensation.

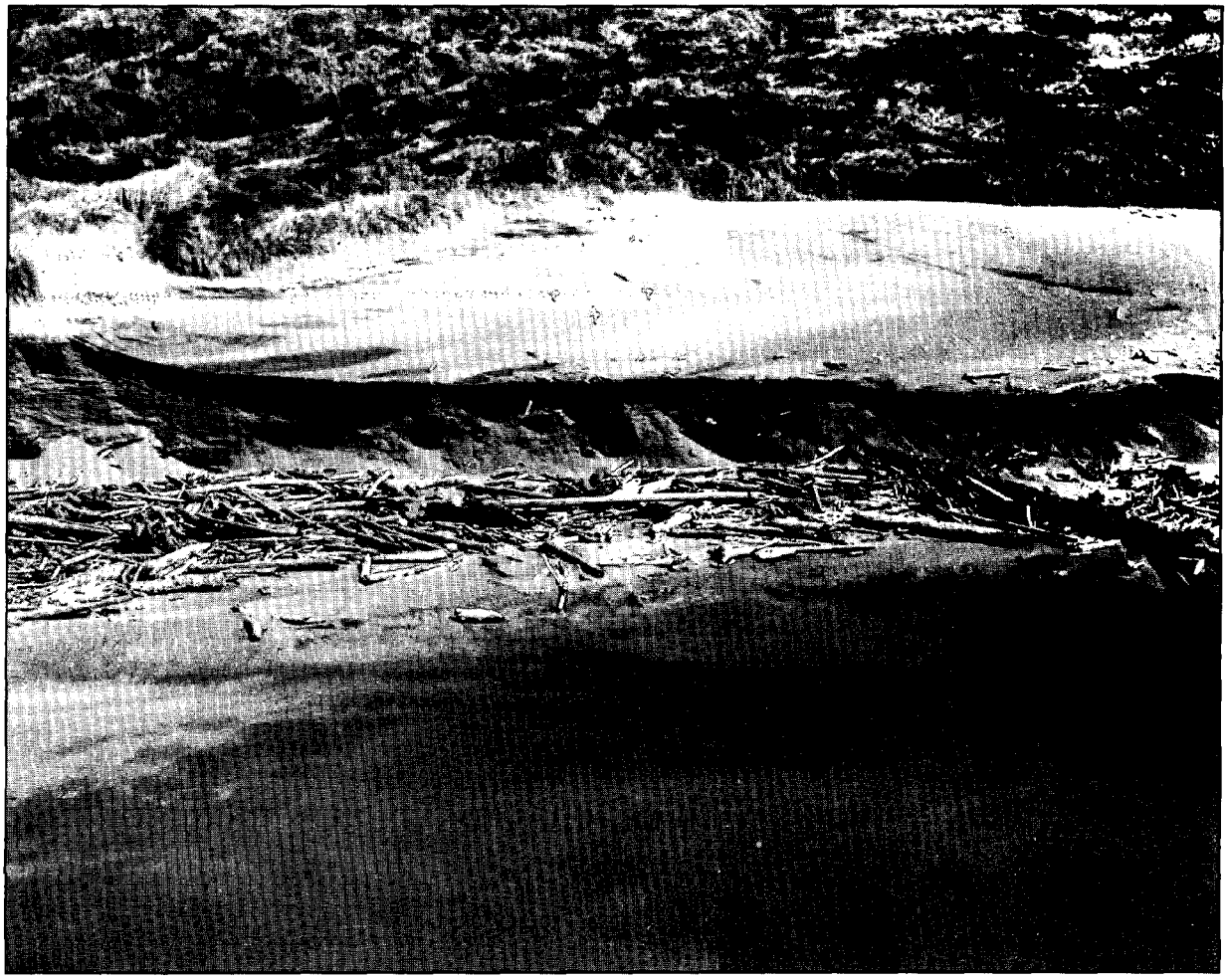
Other development in hazardous areas occurs because technical information about hazards is of poor quality or simply not available. If it is available, it may not be accessible to those who need it or applied properly to the situation. For example, people who purchase property for development are often unaware of hazards.

Often, when owners do learn of the hazards, they believe they can be adequately mitigated through engineering or other approaches. While this is true in some cases, there are often hidden public and private costs involved. Failure to account for the public costs may, in effect, result in a public subsidy of private development. Such hidden costs are rarely accounted for or factored into decision making. Examples are the installation and repair of public infrastructure (sewer, water supply, streets); grants, loans, and loan guarantees; and subsidized insurance.

In this section, we address the following six issues, making recommendations for each:

- lack of integration and coordination of hazards planning in land use, shore protection, and beach management
- public subsidies for development in hazardous areas

- lack of guidelines for determining whether an oceanfront lot is buildable
- effects of past decisions and existing uses on future development in hazardous areas
- ineffective oceanfront construction setbacks
- siting of development in earthquake and tsunami hazard areas



Undeveloped, erosion-prone dunes and shorelands along the southern Oregon coast. Will they be developed in the future and, if so, how will hazards be avoided (ODOT photo)?

Issue 9

Land use planning and site-specific land use decisions, as they relate to coastal hazards, suffer from ineffective integration of existing and new hazards information, piecemeal decision making, and poor communication and coordination among administrators of land use, shore protection, beach management, and hazards research programs.

Although there is broad recognition of the need to thoroughly integrate natural hazards concerns into land use planning, and to coordinate this planning with shore protection, beach management, and hazards information development, the principal mechanism for accomplishing this—the local comprehensive plan—has not been particularly effective. Comprehensive plan policies are vague and inconsistently applied by planners with little of the needed expertise. Further, there is little impetus for improving plans, policies, or their implementation. As a consequence, hazard-related decision making is usually limited to simplistic site-specific or single-jurisdiction concerns. More complex site development issues and offsite effects of projects are not generally identified or considered. Similarly, the strong influences and controls on hazards exerted by larger-scale geologic, hydrologic, and oceanographic processes or conditions are not considered.

Findings

The principal authorities and responsibilities for beach and upland management are divided among OPRD, DSL, DOGAMI, DLCD, FEMA, the Corps of Engineers, and local governments, although other agencies may be involved in some cases. But the specific roles and responsibilities in any given project are often unclear, not just to the affected public, but sometimes to the regulatory agencies themselves. This situation has led to a high level of frustration for the general public when faced with the prospect of involvement by more than one agency, each with its own set of standards and criteria for approval. It has also led to conflicts between the various governmental agencies involved as to who is responsible for what and when. Gaps and overlaps in jurisdiction result in inadequate oversight of some projects, duplication of effort in others, and public complaints about the loss of two very important resources—time and money. Unclear division of responsibility has also raised concerns over the lack of accountability and the enforcement of existing regulations.

For example, there is a recurring coordination problem between local governments that issue oceanfront development permits and the state agencies that regulate shore protection. Local governments are not required to notify shore protection regulators (OPRD and DSL) when they issue local development permits. If building construction setbacks and other hazard mitigation are insufficient, as they often are, subsequent erosion or bank slumping can generate requests for hard shore protection structures. The need for these hard structures could be avoided if the state agencies responsible for beach management were adequately informed and could recommend more appropriate setbacks. In the absence of improved local-state coordination, hard SPSs are likely to proliferate along developing shorelines.

Except for several efforts at regional, advanced planning for foredune areas, oceanfront development and shore protection decisions are made case-by-case, are based on weak local comprehensive plan policies or general coastwide policies, and rarely take into account the highly variable physical character and patterns of human development found along the coast. For example, the subdivision of the coast by rocky headlands into discrete littoral cells and subcells is given little consideration in planning and management. These cells form natural planning units for natural hazards management, varying in a number of important ways: tectonic uplift rates and relative sea level rise; supply of sand from rivers and sea cliffs and distribution along the shore; beach and land erodibility and stability related to

geologic and oceanographic factors; susceptibility to ocean flooding and tsunami inundation; and potential for amplified ground shaking and liquefaction caused by major earthquakes. Also contributing to this variability are institutional and cultural factors such as jurisdiction and management authorities, ownership patterns, land use and development pressure, and attitudes toward development and private property rights. These physical and cultural differences among and within cells suggest that no one set of planning or management solutions to natural hazards problems will work for every area along the coast. They also suggest that natural hazard management cannot work well without some more effective means of coordination, because decisions or actions in one community sometimes have adverse effects on the beach or upland properties in adjacent jurisdictions.

A planning process that promises improved coordination and more rational planning boundaries is "special area management planning" (SAMP). Variations of the SAMP process have been developed and applied to many geographic areas and situations throughout coastal United States and the world, including harbors, revitalization of waterfronts for mixed use, groundwater quality protection, and ocean shore and beach areas. The federal Coastal Zone Management Act encourages states and local jurisdictions to use the SAMP process. Oregon's Estuarine Resources Goal 16 and the local estuary plans that resulted were based on a SAMP-like framework and process; they are considered one of the most effective problem-solving parts of Oregon's Coastal Management Program.

Such a planning process, adapted to Oregon's beachfront areas, could address the variety of issues discussed above, as well as other issues dealt with later in this report, such as unbuildable lots (Issue 11), the differences between developed and undeveloped areas (Issue 12), building construction setbacks (Issue 13), new information on earthquake and tsunami hazards (Issue 14), and shore protection procedures (Issues 5 through 8).

The Special Area Management Planning (SAMP) Process

General features of the SAMP process include

(1) intergovernmental collaboration among local, state, and federal agencies, along with other stakeholders (for example, property owners and beach user groups);

(2) agreement by consensus;

(3) integration of federal, state and local legal requirements;

(4) meaningful public involvement;

(5) specified mechanisms for implementation that are "owned" by those who must use them; and

(6) decision making processes that are stratified and well-coordinated.

Recommendations

Recommendation 9-1. Adapt the SAMP process to oceanfront beaches and shorelands along the Oregon coast. Undertake a pilot SAMP for a high-priority oceanfront area to test, evaluate, and refine the planning guidelines outlined below. Identify other priority coastal areas for application of the refined SAMP process.

The overall goal would be to improve coordination among local and state regulatory programs by establishing consistent policies and procedures in advance of specific applications for upland development, dune grading, shore protection, or other beach or shoreland activity related to natural hazards.

Following is a preliminary framework for SAMP along the Oregon coast:

a. Establish potential SAMP areas based on these criteria:

1) cultural and physical interconnections, both alongshore (for example, jurisdictional boundaries, littoral cells or subcells) and cross-shore (for example, inland streets and highways, land use, shorelands with unstable cliffs and bluffs, areas subject to wave undercutting and overtopping, earthquake-

related hazards, including tsunami inundation areas, soil liquefaction, and landslides)

2) the mix of public and private shoreland ownership, giving priority to areas that are predominantly private

3) an inventory of developed and undeveloped lands, and a forecast of development pressures on these lands

4) the nature and severity of coastal natural hazards

5) existing or potential land use or beach-related conflicts, and similar criteria

b. For the entire coastline, classify hazard-influenced ocean coastlines where SAMP might be appropriate, identifying the highest intensity of development that will be permitted to occur in each area. Factors to be considered might be regional and local geologic and oceanographic features, existing land ownership and the location and intensity of development, the vulnerability of existing and potential development to chronic and potentially catastrophic natural hazards, the existing and potential need for hard shore protection structures, existing beach, dune, and other recreational resources, scenic and aesthetic values, aquatic and upland wildlife resources, and conflicts.

c. To begin the individual SAMP process, develop an inventory that identifies, describes, and maps chronic and catastrophic hazards as they affect beaches and oceanfront and estuary shorelands and relevant cultural, recreational, economic, and other

Special area management planning (SAMP) for stretches of coastline that are physically interconnected would solve some of the problems now faced by property owners and governmental agencies charged with beach and land use management (J. Good photo, from Cascade Head looking south toward Lincoln City and Gleneden Beach).

resources and values. Include the following specific inventory requirements:

1) Chronic hazards—identify beach and upland areas made unstable by erosion or flooding caused by ocean waves, or mass wasting caused by geologic instability, stream or groundwater hydrology, physical or chemical weathering, or human alterations.

2) Catastrophic hazards—using a credible CSZ earthquake and tsunami scenario, map the areas and expected degree of amplified ground shaking, coseismic subsidence, soil liquefaction or settling, induced landslides, tsunami inundation, and seiches.

3) Cultural characteristics—determine land ownership and values; existing patterns, types, intensities, and location of development with respect to natural hazards (for example, building setbacks) and how these might influence future development; beach and other recreational resources; scenic and aesthetic values; and aquatic and wildlife resources; land use and related conflicts.

d. Consistent with the overall area classification, establish beach and shoreland management units within SAMP areas; each management unit should provide for appropriate types and intensities of development and require the use of particular strategies and techniques for hazard avoidance and mitigation. As needed, also provide for especially tailored management units within SAMP areas.

e. Implement oceanfront SAMPs using a model ordinance that covers both local land use decision making and at the state level issuing shore protection permits (for example, a multipurpose coastal hazard overlay), modified as needed to suit local conditions. The ordinance should require the incorporation of new information as it becomes available. Include appropriate management techniques detailed elsewhere in this report, including setbacks, coordination requirements, and enforcement procedures.

Implementing Actions for Recommendation 9-1

9-1 A. The Land Conservation and Development Commission (LCDC) should establish an oceanfront SAMP framework and process as Statewide Planning Goal amendments to Goal 7 (Natural Hazards), Goal 17 (Coastal Shorelands), and Goal 18 (Beaches and Dunes).

9-1 B. LCDC should establish a Coastline Classification Task Force to establish and apply classification criteria; the results of the classification process should be adopted by administrative rule.

9-1 C. DLCD, in consultation with local governments, OPRD, DOGAMI, and other relevant agencies and interest groups, should select a pilot SAMP area, giving priority to areas within the pilot mapping project area (see Issue 1); the pilot SAMP should be funded with federal coastal zone management grants.

9-1 D. Cities, counties, special districts, DLCD, OPRD, DOGAMI, DSL, other relevant state and federal agencies, interest groups, and affected and interested citizens should develop SAMPs for appropriate oceanfront areas. Funding assistance should be provided through federal coastal zone management grants.

Recommendation 9-2

Establish a local land use notification process for oceanfront development projects that could lead to future OPRD-regulated shore protection proposals. Because most such projects are single-family dwellings, keep the process as simple as possible. Notifications could be triggered by an existing process (for example, individual building permits, subdivisions, or other discretionary land use actions), requirements for geotechnical site reports, the availability of improved hazard maps and information, or other criteria, at the discretion of local governments. Send notifications to OPRD, who will notify other agencies, such as DOGAMI and DLCD, as needed. For areas with an approved oceanfront SAMP, such a process could be eliminated.

Implementing Action for Recommendation 9-2

9-2. If it has sufficient authority under ORS 197, ORS 215, or ORS 227, LCDC should amend Goal 17 (Coastal Shorelands) and 18 (Beaches and Dunes) to require a local land use notification process for natural hazards, according to Recommendation 9-2. Alternatively, if it does not have authority, LCDC should seek such authority or propose appropriate legislative action to implement this recommendation.

Issue 10

Development in hazardous areas is often subsidized by public funding.

Land development in hazardous areas is often subsidized by public investments in community and transportation infrastructure, through grant and loan programs, insurance programs, and federal or state disaster response and postdisaster bailouts.

Findings

Coastal land development in areas subject to natural hazards is often promoted or subsidized through local, state, and federal programs or incentives. The full cost of these programs, particularly the costs of maintenance and repairs, and disaster relief and reconstruction, is rarely considered in decision making. Examples of subsidies in hazardous areas are (1) the extension of public services at public cost (water, sewer, streets, etc.); (2) the increased local cost of regulation, technical assistance, and inspection of such development; (3) the provision of subsidized hazard insurance (for example, for flooding), government grants, low-interest loans, and loan guarantees; (4) tax deferments, write-offs, or other tax relief; and (5) disaster relief. Disaster relief is often paid out in greater sums than would be required if individuals, businesses, and the public sector had taken voluntary hazard mitigation measures ahead of time. Perhaps most troublesome is the additive nature of some of these subsidies; public tax monies are used to encourage unwise development that later must again be publicly subsidized with disaster relief monies.

The National Flood Insurance Program is one of the major programs cited as examples of subsidies that promote unwise development. On the other hand, the National Flood Insurance Program requires that developers take certain measures to mitigate the effects of hazards, and its proponents argue that these measures limit potential losses. Whatever the case, a number of studies have shown that individuals, businesses, and even public entities do not voluntarily adopt protective measures against flood hazards (Kunreuther 1993). The result is huge disaster relief bills. No data is available for Oregon, but significant natural hazard damage risks exist, particularly for large CSZ earthquakes. Given this reality, there is increasing interest in expanding federally subsidized insurance programs to cover other hazards. For example, for several years, the U.S. Congress has been debating legislation to expand the program to cover erosion hazards (the program would require substantial coastal construction setbacks as mitigation). The insurance industry has encouraged the government to enter the earthquake insurance arena. This is supported by a recent government study that cites the lack of private coverage in earthquake-prone areas as a serious threat to the federal treasury due to potential disaster relief costs.

Recommendations

Recommendation 10-1

Eliminate tax write-offs for capital losses for new structures or major additions to existing structures, built after January 1, 1996 (or some other date), when that loss is caused by erosion, landslides, or other chronic hazards, or by earthquake or tsunami hazards in designated high-hazard areas. High-hazard areas are those designated on maps developed in response to Recommendation 1-3. Until such maps are available, determine high-hazard areas by evaluating site-specific geotechnical information provided for land use decisions or building permits.

Implementing Action for Recommendation 10-1

10-1. The Oregon State Legislature should amend the tax code to eliminate hazard-related tax write-offs according to Recommendation 10-1.

Recommendation 10-2

Establish development surcharges for building permits and land use actions in high-hazard areas consistent with the actual costs of development. The charges should include the full cost of project review, evaluation, and decision making. If feasible and defensible, include the estimated future costs of maintenance, repair, or removal of associated infra-

structure, basing these costs on well-defined criteria.

Implementing Action for Recommendation 10-2

10-2. Cities and counties should establish appropriate development surcharges for hazardous areas.

Recommendation 10-3

Establish a process for evaluating coastal natural hazards in government development, grant, and loan procedures. Hazard evaluation should, at a minimum, include an assessment of erosion, landsliding, and earthquake and tsunami hazards.

Implementing Action for Recommendation 10-3

10-3. Each federal, state, and local development, grant, or loan agencies should establish, by administrative rule or policy, a means for evaluating natural hazards as part of its decision-making process.

Recommendation 10-4

Prohibit direct public development, grants, loans, or loan guarantees for essential facilities, hazardous facilities, major structures, and special occupancy structures (as defined by ORS 455.477; see Issue 3) in high-hazard areas. Exceptions would be situations where such hazards are fully mitigated by structural or nonstructural means or when the facility cannot be feasibly located outside high-hazard areas (for example, port facilities, marinas, other water-dependent facilities, water and waste treatment facilities, and similar uses). Public subsidies of other types of development in high-hazard areas should generally be discouraged.

Implementing Action for Recommendation 10-4

10-4. Federal, state, and local agency policies governing approval of government development, grants, loans, or other assistance should be amended to prohibit public subsidy of essential facilities, hazardous facilities, major structures, and special occupancy structures in high-hazard areas. Public subsidies for other types of development in high-hazard areas should be discouraged. Programs of the Economic Development Department should be given particular scrutiny, but all federal, state, and local agencies should carefully evaluate their programs for possible direct or indirect subsidies to development in high-hazard areas. The A-95 process used to review federal grants and programs should incorporate an evaluation of high-hazard areas.

Recommendation 10-5

Expand the National Flood Insurance Program to an all-hazards program, covering at least erosion, earthquakes, and tsunamis for residences, businesses, and public buildings. Specific provisions for such a program are as follows:

a. Couple all-hazards insurance with stringent mitigation requirements designed to minimize disaster losses (for example, coastal construction setbacks [see Recommendations 13-1 to 13-4] and building standards appropriate for high-hazard areas [see Recommendation 15-3]; and others).

b. For earthquake and tsunami hazards, ensure consistency with other recommendations in this report, particularly Recommendations 14-1 to 14-5 concerning the siting of development in earthquake and tsunami areas.

c. Require that such insurance be a condition for receiving and maintaining mortgage loans in these hazard areas.

Implementing Action for Recommendation 10-5

10-5. FEMA should support and the U.S. Congress should enact an all-hazards insurance program that combines substantive mitigation requirements for reducing actual damages with financial protection in the event of losses. Provisions for tailoring the federal program to West Coast conditions should also be included in such legislation and any implementing regulations.

Issue 11

There is no consistent way to determine what properties along the Oregon coast are "unbuildable" due to natural hazards.

There are no clear or consistent guidelines for determining whether a property is buildable or unbuildable with respect to natural hazards. Definitions of buildable and unbuildable, responsibility for making such determinations, and decision-making procedures are lacking. It is also unclear what the legal and political consequences of such determinations would be, particularly with respect to infill development, public liability, and the "takings" issue. Finally, current policy does not address how properties change over time from being buildable to unbuildable or vice versa based on new information, new technology, the effect of actions on neighboring properties, and natural hazard events.

Findings

Natural hazards effectively render some coastal properties unbuildable, although engineering technology makes development of many hazard-prone sites possible if the property owner or developer is willing to invest the needed dollars. However, there is a difference between what is physically possible at a specific site at a given time and what may be consistent with the public interest. Unfortunately, there is no policy or mechanism for local governments to factor in the public interest when making a decision as to whether or not a lot in a hazard-prone area is buildable. Instead, the site development process focuses on whether or not hazards on the site can be sufficiently reduced to allow development to go forward.

Rarely have decisions about whether a site is buildable or unbuildable been made in advance (that is, during local comprehensive planning). However, one clue to this question as it relates to individual properties is the assessed value of a site as determined by local tax assessors. For example, if a shallow oceanfront lot is assessed at $3,000 while the adjacent deep lot is assessed at $60,000, it might be assumed that the assessor felt the former property was unbuildable (figure 7). However, such determinations have little meaning in the land use decision-making process.

Not having explicit policies to determine whether or not a site is buildable or unbuildable results in a number of problems: protracted deliberation, debate, or litigation over specific proposals at either public or private expense; inappropriate development with adverse scenic, visual, and physical impacts on the beach or upland; and diminished beach recreational values.

Recommendations

Recommendation 11-1

Establish a classification system and criteria for determining development capacity of oceanfront lots with respect to hazards. Apply the system on a jurisdiction-wide basis or through an established SAMP process (see Issue 9). A prototype classification system, based on the vulnerability to natural hazards and the possible need for property-owner compensation or hazard mitigation, is outlined below:

a. buildable with no special hazard mitigation requirements other than hazard avoidance (for example, adequate building setback or design features)

b. buildable with appropriate hazard mitigation (mitigation must be privately financed)

c. unbuildable, based on an evaluation of property rights, physical constraints, and public interest factors such as the following:

   1) Public ownership or public easements exist (for example, the lot or the major portion thereof is on the beach or in the water).

   2) Physical constraints exist which preclude development without extraordinary structural mitigation measures (for example, the lot is very narrow or is located in an active landslide or active foredune area).

3) Construction would constitute a public nuisance under common law principles.

4) Construction would alienate public rights protected by ORS 390 (Oregon Beach Law), including public access to and along the beach, public safety, and scenic and recreational values.

Implementing Action for Recommendation 11-1

11-1. By rule or other enforceable policy, LCDC and DLCD should prepare and adopt rules for determining whether a lot is buildable or unbuildable. Local governments should incorporate the procedures into the SAMP process (see Recommendation 9-1).

Recommendation 11-2

Amend the Oregon Tax Code to provide owners of hazard-prone property with an enhanced tax credit (for example, 150 percent of assessed value) for donating property to a public entity or a private, nonprofit land trust for permanent, nondevelopment-related public use (for example, to OPRD, local park authorities, federal park or conservation authority, or private land conservancy).

Implementing Action for Recommendation 11-2

11-2. The Oregon State Legislature should amend the tax code to provide for an enhanced tax credit according to Recommendation 11-2.

Recommendation 11-3

Establish a public fund to purchase fee simple or development rights to property that is deemed unbuildable based on the criteria in Recommendation 11-1. The deed for such property should be held by OPRD or similar authority, have substantial public value, and be preserved in perpetuity as undeveloped open space.

Implementing Action for Recommendation 11-3

11-3. OPRD should consider and evaluate alternatives for developing, administering, and managing a fund to implement this recommendation. A funding mechanism for such a program is needed.

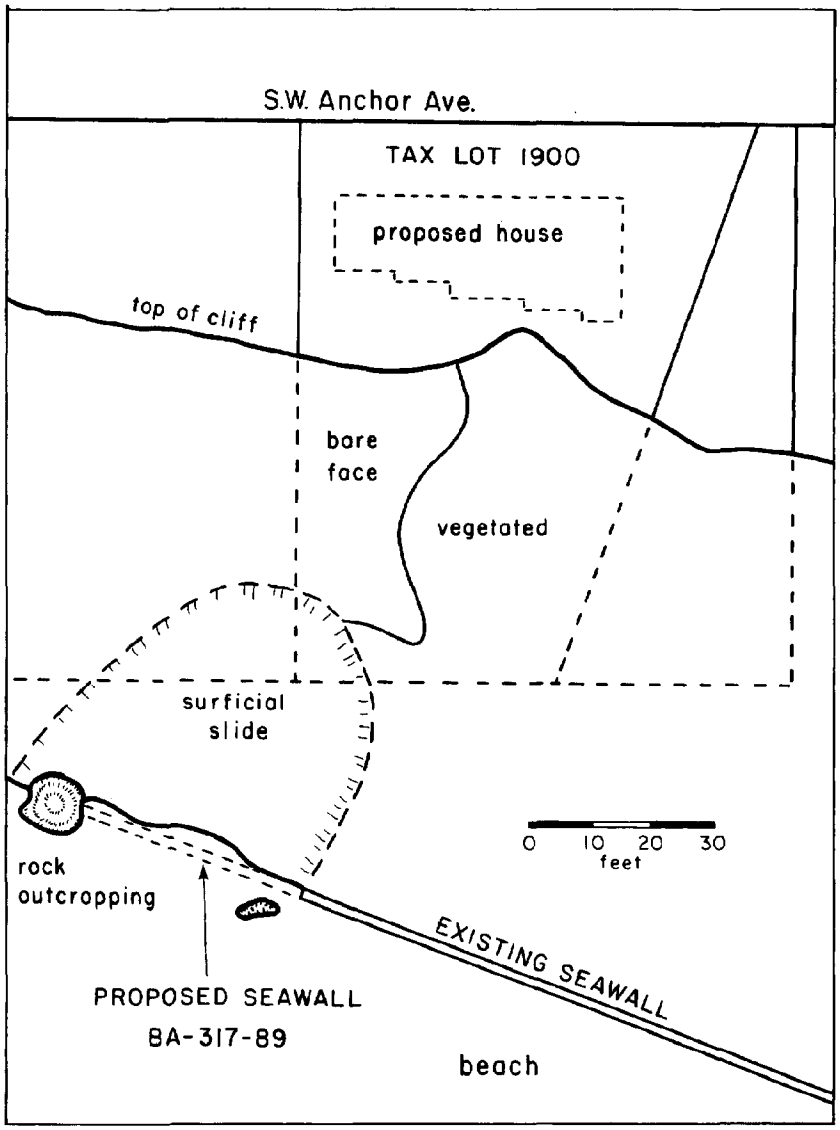


Figure 7.—This parcel in Lincoln City (tax lot 1900), perched 75 feet above the beach on an eroding sea cliff, is a good example of a marginally buildable lot. Assessed for $5,450 in 1991, it was put up for sale at $77,000 following construction of a small seawall at the base of the cliff.

Issue 12

Past land use decisions and existing uses unduly influence decisions on new development.

Past decisions about private and public development that did not fully consider coastal natural hazards often influence or prejudice today's land use decisions. Because of previous commitments to development, critical facilities, industrial, commercial, and residential buildings, streets, highways, infrastructure, etc., are sometimes sited in areas now known to be hazardous or even life threatening. Examples include extension of sewer and water lines into undeveloped areas and subdivisions laid out without due consideration of natural hazards.

Findings

Many coastal properties are committed to development at some level. Examples are existing subdivisions, installed infrastructure, and infill development of vacant lots in areas previously approved for development. Hazardous areas that were undeveloped earlier are now being developed or filled in. This continues to occur despite improved hazard information that suggests that either no development should take place or that changes in site plans are needed to avoid or mitigate natural hazards. The unlimited time frame for subdivision development, particularly in rural lands, creates the potential for similar problems. In the same manner, installing infrastructure without full consideration of its impacts also encourages development of hazardous property.

Recommendations

Recommendation 12-1

Subdivisions. Improve subdivision procedures with respect to natural hazards as follows:

a. Establish a sunset clause for new subdivisions that limits the time allowed for development to occur and provides for automatic vacation of the subdivision at the time of sunset.

b. Review previously approved subdivisions as required by ORS 92.205-92.245 (Undeveloped Subdivisions), modifying or vacating as appropriate. Base the decision to modify or vacate, in part, on an evaluation of natural hazards affecting the property (for example, erosion rates on the potential for oceanfront lot setback requirements, the potential for tsunami inundation).

c. Simplify plat vacation and reconfiguration procedures to expedite the process.

Implementing Action for Recommendation 12-1

12-1. If sufficient authority exists, local governments should implement these recommendations during periodic review of local comprehensive plans, development of oceanfront SAMPs, or independently. If such authority does not exist, DLCD should propose legislative action to authorize these subdivision procedures.

Recommendation 12-2

New Infrastructure. When a public or private infrastructure extension is proposed to service new development, evaluate the extension for its potential to influence land development in hazardous areas. When an evaluation suggests increased hazard risks or impacts, require that the infrastructure extension be modified to eliminate or minimize such adverse impacts.

Implementing Action for Recommendation 12-2

12-2. LCDC should amend the Public Facilities Goal 11 to require a hazards assessment of new infrastructure development. Local governments should update local coordination agreements and ordinances at periodic plan review or during development of SAMPs.

Recommendation 12-3

Existing Infrastructure. Evaluate existing public infrastructure in areas not yet built up for its influence on land development in hazardous areas. Where reasonable, abandon,

relocate, or otherwise restrict development to minimize threats to life or property.

Implementing Action for Recommendation 12-3

12-3. LCDC should amend the Public Facilities Goal 11 to require a hazards assessment of existing infrastructure development. Local governments should update local coordination agreements and ordinances at periodic plan review or during development of SAMPs.

Development continues to fill in on previously subdivided property in Pacific City without regard to obvious erosion hazards; unless the unbuilt lots are abandoned, the only available hazard mitigation is shoreline armoring with riprap (ODOT photo).

Issue 13

Oceanfront construction setbacks, as now implemented, have not proven to be an effective means for avoiding hazards.

Construction setback procedures for buildings along the oceanfront vary among coastal jurisdictions and differ in their effectiveness. Variances to required setbacks are common, leading to development of marginally buildable properties, placing upland improvements at risk, and creating demand for otherwise unnecessary shore protection structures. Overly permissive allowances for density and lot coverage are sometimes the basis of setback variances. In areas where buildable portions of oceanfront lots are shallow, required setbacks may effectively render lots unbuildable.

Findings

The use of mandatory coastal construction setbacks as a means of avoiding hazards and preventing loss of property is a well-accepted coastal management tool throughout the United States and other parts of the world. In Oregon, several state-level general planning policies relate directly or indirectly to setbacks. Statewide Planning Goal 7 states "development shall not be...located in areas subject to hazards without appropriate safeguards." Goal 17 requires that "land use management practices and non-structural solutions to problems of erosion and flooding shall be preferred...." And Goal 18 prohibits most development "on beaches, on active foredunes, and on other foredunes which are conditionally stable and are subject to ocean undercutting or wave overtopping, and on interdune areas (deflation plains) subject to ocean flooding."

Although these policies provide some guidance to local governments, the state has no specific technical guidelines for determining setbacks. Each local jurisdiction thus uses its own procedures and criteria; some are more effective than others. Setbacks that are too small may quickly place upland buildings at risk and create demand for seawalls or riprap revetments. These SPSs, in turn, may adversely affect neighboring properties, the public beach, and scenic and recreational qualities protected under the 1967 Beach Law.

Other kinds of problems arise in partially built-up areas (infill development) or where required setbacks are large enough to render property unbuildable. In these cases, setback waivers are often granted. Resulting setbacks may be based on existing setbacks for neighboring properties (in the case of infill) or on site-specific analysis and recommendations. These recommendations often call for installation of a SPS in lieu of an appropriate setback. There is concern that new subdivisions continue to be approved with oceanfront lots that may be too shallow for adequate construction setbacks.

Another problem on lots where only a portion of the lot is deemed buildable (for example, where part of the lot is upland and part is on the beach) is that some local governments use the entire lot, rather than just the buildable portion, to determine lot coverage and density allowances. As a result, developments cannot proceed without setback variances that unnecessarily place development at risk or lead to proposals for seawalls or revetments.

Recommendations

Recommendation 13-1

Develop, test, and refine a coastwide technical methodology for coastal construction setbacks, whereby each property would be evaluated on its unique characteristics using the most up-to-date information available. Factors to consider for this formula-based approach are as follows:

a. wave run-up and surge potential for a 100-year storm (assuming spring tides)

b. local beach and dune erosion or accretion rates

c. landform and geology

d. historic rate of sea cliff recession

e. the type, intensity, and expected life span of the proposed development

f. tsunami inundation limit and run-up height

g. whether the property was "undeveloped" on January 1, 1977, in which case setbacks should be greater because hard shore protection structures are not permitted under Statewide Planning Goal 18

Implementing Action for Recommendation 13-1

13-1. LCDC should amend the Coastal Shorelands Goal 17, requiring that DLCD, in cooperation with DOGAMI, OPRD, and coastal local governments, develop a consistent coastal construction setback methodology. Once a reliable method is in place, it should be adopted by administrative rule and included in the content standards for geotechnical reports (see Issue 2). Funding should be provided through the Coastal Hazards component of the Coastal Zone Management Act Section 309 program for Oregon.

Recommendation 13-2

Require use of the coastal construction setback method (Recommendation 13-1) for all shoreline development subject to coastal natural hazards. Have coastal construction setbacks for upland buildings and infrastructure determined by a qualified professional and include these setbacks in site-specific geotechnical reports or other project proposals.

Implementing Action for Recommendation 13-2

13-2. LCDC should require use of the approved coastal construction setback methodology; it should be adopted by administrative rule and included in the content standards for geotechnical reports (see Issue 2).

Recommendation 13-3

Allow variances to required coastal construction setbacks only when *all* of the following conditions are met:

a. It is demonstrated that building design (footprint and overhangs) and proposed construction techniques minimize exposure to natural hazards.

b. It is agreed upon and established by variance condition that no concurrent or future hard shore protection structures will be permitted on the property.

c. Maximum setback variances on other parts of the property (sides and street or back) have already been granted and incorporated into the design.

Implementing Action for Recommendation 13-3

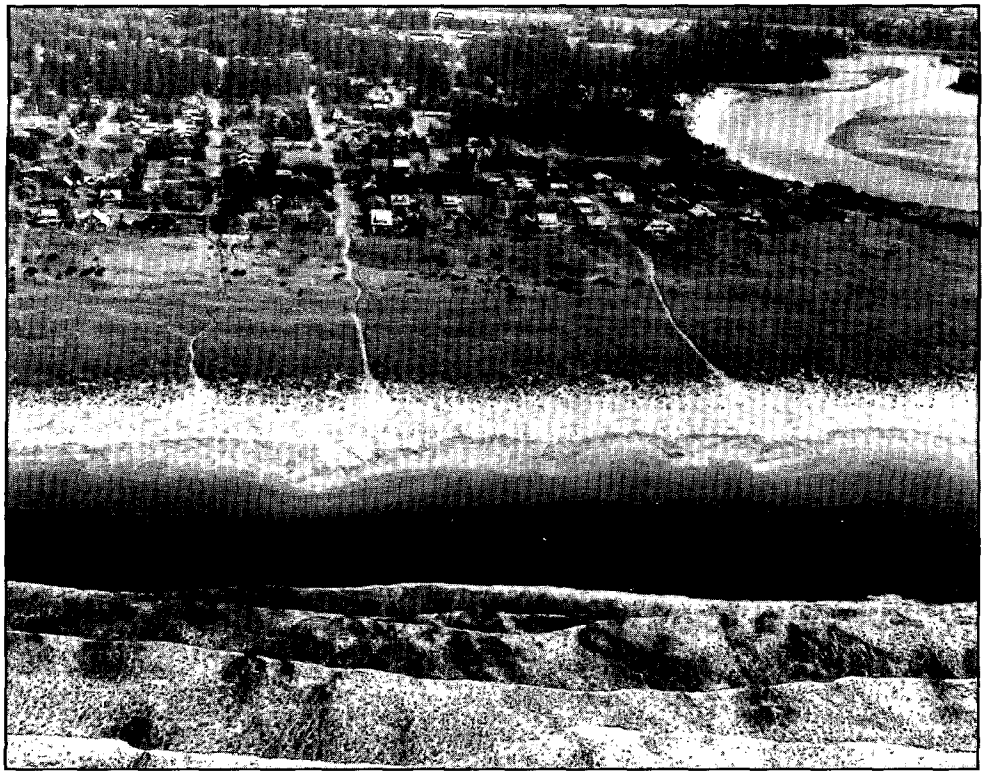
13-3. Through administrative rules or through amendment of the Coastal Shorelands Goal 17, LCDC should set limits on variances to coastal construction setbacks.

Recommendation 13-4

Do not allow the use of lot coverage or building density allowances as the basis for a variance to required coastal construction setbacks.

Implementing Action for Recommendation 13-4

13-4. Through administrative rules or through amendment of the Coastal Shorelands Goal 17, LCDC should set limits on variances to coastal construction setbacks.



Construction setback regulations differ markedly from jurisdiction to jurisdiction, resulting in distinctly different land-use patterns and scenic character (top, city of Gearhart; bottom, Coronado Shores, Lincoln County) (ODOT photos).

Issue 14

Development continues to be sited in earthquake and tsunami high-hazard areas.

Decisions on land use planning, siting, or capital expenditure for public or private infrastructure, critical and lifeline facilities, and residential, commercial, industrial, and other development do not explicitly factor in potential earthquake-related hazards, including amplified ground shaking, soil liquefaction, ground subsidence or uplift, fault rupture zone location, landslide potential, or tsunami or seiche inundation and run-up.

Findings

In the last few years, Oregonians have become aware of their vulnerability to extreme earthquake hazards, particularly on the coast. Just 20 to 40 miles offshore lies the longest and potentially most dangerous fault zone in North America (the 700-mile long CSZ—see figure 1). There is a 10 to 20 percent probability of a major quake (magnitude 8-9+) along the CSZ in the next 50 years. Hundreds of other crustal faults that crisscross the shoreline could be activated by a major quake. While adequate disaster preparedness is essential for saving lives, it is also critical that the state integrate earthquake-related considerations into its land use planning and development process, especially given the recent acceleration of coastal development. If appropriate land use measures are implemented now, it will save lives, reduce property losses, and facilitate effective disaster response when the inevitable CSZ quake does strike.

Of special concern with respect to hazards is the siting of lifelines and critical facilities (highways, water lines, fire and police facilities, hospitals, etc.) and other development that attracts large groups of people or people with limited mobility (schools, nursing care, shopping centers, etc.). Of particular concern for the latter groups are evacuation times and routes.

To prohibit all new construction in earthquake and tsunami high-hazard areas and to relocate existing development away from these areas would severely curtail economic development in coastal communities and ports. Such a move is not practical or justifiable. However, strictly limiting some kinds of new development and gradual replacement of some older facilities located in these areas make good economic sense and at the same time promote public safety.

Recommendations

Recommendation 14-1

Establish a system of special zones, procedures, restrictions, and conditions to limit development in earthquake and tsunami high-hazard areas (figure 8). Such a system would include the means to determine the appropriate level of allowable activities, depending on the hazard. It would need to be based on relatively sophisticated information and mapping that would include a determination of the hazard area, an evaluation of the hazard, an evaluation of the severity, and the level of allowable risk (see Recommendation 1-3).

Implementing Action for Recommendation 14-1

14-1. LCDC, in cooperation with DOGAMI, cities, counties, and emergency managers, should amend Goal 7, giving special attention to earthquake and tsunami hazards. On the basis of those amendments, they should develop administrative rules that incorporate detailed guidelines for land use related to these hazards, including the special zones, procedures, restrictions, and conditions (for example, see Recommendation 14-2).

Recommendation 14-2

Prohibit the construction of or significant additions to essential facilities, hazardous facilities, major structures, and special occupancy structures in earthquake and tsunami high-hazard areas.

Implementing Action for Recommendation 14-2

14-2. Rules established under Recommendation 14-1 should include the prohibition recommended in Recommendation 14-2. Cities and counties should evaluate high-hazard areas under their jurisdiction and rezone them accordingly.

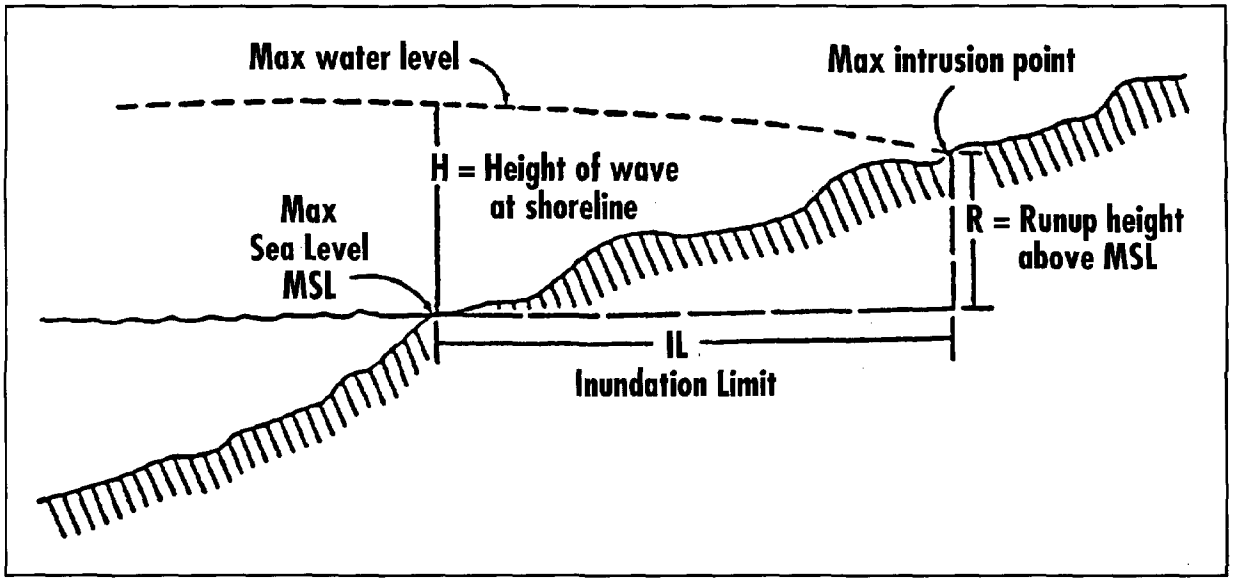


Figure 8.—Areas that would be inundated by a tsunami generated by a large CSZ earthquake need to be mapped all along the coast.

Recommendation 14-3

Limit other types of development in high-hazard areas to low-intensity uses. In addition, establish specific conditions and building standards for development that will prevent collapse of structures when they are subjected to expected earthquake or tsunami forces.

Implementing Action for Recommendation 14-3

14-3. Following rules established under Recommendations 14-1 and 14-2, cities and counties should evaluate high-hazard areas under their jurisdiction and rezone them or establish appropriate permitted uses or development conditions and standards for them.

Recommendation 14-4

Develop long-range plans to phase out existing essential facilities, hazardous facilities, major structures, and special occupancy structures located in earthquake or tsunami high-hazard areas. Similarly, phase out or relocate utilities and other infrastructure in these high-hazard areas when normal replacement or major overhaul is due.

Implementing Action for Recommendation 14-4

14-4. City and county planning and development authorities, in cooperation with emergency management officials, utilities, and other private parties, should develop and implement a long-range plan for phasing out these structures, facilities, and infrastructures.

Recommendation 14-5

Incorporate information on tsunami run-up associated with forecasted CSZ earthquakes into the National Flood Insurance Program and rate maps as data becomes available.

Implementing Action for Recommendation 14-5

14-5. In coordination with DOGAMI, FEMA should revise its flood insurance rate maps to incorporate locally generated CSZ tsunami hazards.

What, where, and how to develop in areas subject to tsunami hazards poses a conundrum for Oregon communities and ports (ODOT photo at Brookings).

Earthquake and Tsunami Disaster Preparedness and Response

There is a growing awareness in the Pacific Northwest that the region is more seismically active than previously thought, that the risks of earthquakes to life and property are great, and that the region is largely unprepared. Three types of earthquakes pose threats: (1) shallow crustal quakes along active faults up to magnitude 6.5, (2) intraplate quakes up to magnitude 7.4 that occur deep within the oceanic Juan de Fuca plate as it bends under the North American plate, and (3) very large CSZ quakes of magnitude 8-9+ that occur offshore at the boundary where the Juan de Fuca and North American plates are locked together (for a more detailed discussion, see earlier section on Natural Hazards Along the Oregon Coast).

Oregonians are not well prepared for the least of these quakes, let alone a potentially catastrophic CSZ event that would be accompanied by severe ground shaking, local subsidence or uplift, soil liquefaction, landslides, and large tsunamis. More and better information is needed about potential earthquake events and the risks they pose to life and property. Response plans need to be updated and exercised, and organizational relationships and responsibilities clarified. Structural mitigation opportunities in the coastal zone need to be identified for new and old buildings, public and private infrastructure, and critical facilities (figure 8). And there needs to be a comprehensive program to educate residents, visitors, and critical service providers about earthquakes and tsunamis, the risks they pose, and how to respond effectively should one or both strike.

We address nine issues in this section, providing specific recommendations for each:

- seismic safety of structures and facilities
- limited public awareness of earthquake and tsunami hazards and the need to plan for a disaster
- inadequate state and local emergency management plans with respect to large earthquakes
- inadequate earthquake and tsunami preparedness in our schools, businesses, and homes
- incomplete organizational structure for emergency management
- insufficient exercise of earthquake and tsunami response plans
- communication networks that are insufficient to deal effectively with large earthquake disasters
- the severe disruption of physical infrastructure, lifelines, and utilities that will accompany a large earthquake
- need for postdisaster reconstruction planning

The City of Seaside and similar communities constructed on low-lying sandy shores are particularly vulnerable to earthquake and tsunami hazards (ODOT photo).

Issue 15

Because they are vulnerable to earthquakes or tsunamis, many structures and facilities, including recently constructed ones, are potentially unsafe.

A large earthquake with strong, sustained ground shaking would likely destroy many buildings in coastal communities, particularly unreinforced masonry structures, nonductile concrete structures, and tilt-up buildings. In low-lying areas, many other types of buildings would also be destroyed by tsunami wave and current forces and by loose debris carried by waters. At present, many essential facilities, hazardous facilities, major structures, and special occupancy structures (as defined by ORS 455.477; see Issue 2) may be at risk. Their vulnerability places a significant number of lives and property at risk in coastal communities.

Findings

Many old and even newer buildings on the coast are vulnerable to intense, sustained ground shaking that would likely accompany a major earthquake and the inundation by tsunamis that likely will follow such an event. Currently, it is unclear what structures would be at risk, but they may include essential facilities, hazardous facilities, major structures, special occupancy structures, and a variety of other key public and private buildings. Without better information on the vulnerability of such structures and facilities, it is difficult to develop priorities for retrofitting existing structures and facilities.

With respect to structural codes, western Oregon, including the coast, recently changed from earthquake zone 2B to zone 3. However, some earthquake experts believe the coast should be upgraded to zone 4 or greater because of the threat of a large CSZ earthquake. Without such an upgrade, some argue, even new structures may be vulnerable to severe ground shaking. Further, local building elevation requirements and other standards designed to mitigate ocean flooding hazards under the National Flood Insurance Program may make some structures more vulnerable to ground-shaking hazards.

Recommendations

Recommendation 15-1

Identify and inspect structures and facilities in coastal communities that are vulnerable to earthquake or tsunami hazards. At a minimum, make a visual inspection, examine the underlying soil, and estimate the survivability of the structure in the event of a major earthquake or tsunami. Communicate the inspection results to local governments and the owners and operators of private structures and facilities (see also Recommendation 21-4). Give inspection priority to

a. essential facilities, hazardous facilities, major structures, and special occupancy structures (as defined by ORS 455.477)

b. unreinforced masonry structures, nonductile concrete buildings, tilt-up structures, and other potentially unsafe structures

Implementing Actions for Recommendation 15-1

15-1 A. DOGAMI, in cooperation with BCD, local building officials and emergency managers, and the private sector, has initiated a reconnaissance-level evaluation of essential facilities, hazardous facilities, major structures, and special occupancy structures. A preliminary report is due in December 1994.

15-1 B. DOGAMI should initiate follow-up studies as warranted, such as the inspections identified in Recommendation 15-1b. Funding should be sought from the Oregon State Legislature as needed.

15-1 C. Cities and counties should be encouraged by DOGAMI to identify and examine vulnerable structures in their communities to eliminate any possible gaps in information.

Recommendation 15-2

Establish procedures for retrofitting, upgrading, or relocating structures and facilities identified as unsafe during inspections con-

ducted in accordance with Recommendation 15-1 (see also Recommendation 21-4).

a. For essential facilities, hazardous facilities, major structures, and special occupancy structures (Recommendation 15-1a), require appropriate retrofitting or other action within the next 20 years.

b. For unreinforced masonry structures, nonductile concrete buildings, tilt-up structures, and other potentially unsafe structures (Recommendation 15-1b), recommend appropriate retrofitting or other action as needed.

Implementing Action for Recommendation 15-2

15-2. BCD, in cooperation with DOGAMI, OEM, local building officials and emergency managers, and structural engineers from the private sector, should develop retrofitting guidelines consistent with this recommendation and adopt them by administrative rule. Local building officials should notify the structure or facility owners of the required retrofitting or other action and enforce it.

Recommendation 15-3

Conduct a study of seismic hazard zones 3 and 4 building code requirements with respect to the sustained ground shaking, liquefaction, tsunami inundation, and other hazards expected during a large CSZ earthquake. Upgrade coastal Oregon building codes to conform with the results of this study with special requirements as needed.

Implementing Action for Recommendation 15-3

15-3. BCD and DOGAMI, in cooperation with local building officials, should evaluate seismic hazard zones 3 and 4 with respect to a CSZ earthquake and implement needed changes for the Oregon coast.

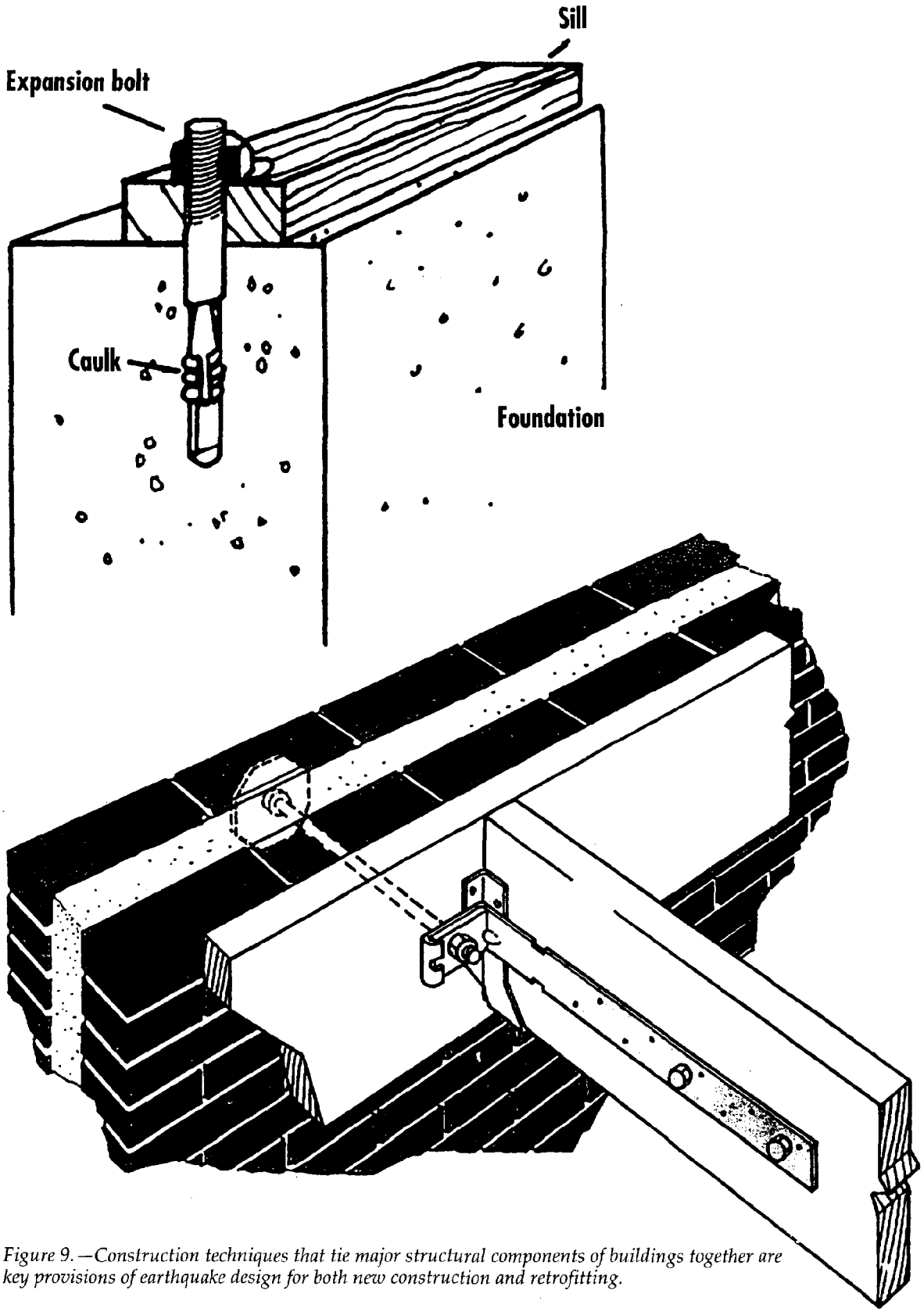


Figure 9.—Construction techniques that tie major structural components of buildings together are key provisions of earthquake design for both new construction and retrofitting.

Issue 16

There is limited public awareness of what earthquake and tsunami hazards are, what risks are involved, and how to plan for or respond to such events.

Most coastal residents and visitors and many government workers and other critical service providers have a limited understanding and appreciation of what is known about earthquake and tsunami hazards and risks in the coastal zone, particularly those associated with a large CSZ event. In addition, there is only limited understanding of how to prepare for and respond to a large earthquake. Although a great deal of general information is available about disaster preparedness and response from sources like the American Red Cross and FEMA, little of this information is tailored to specific areas of the Oregon coast. Such area-specific information is needed to plan a detailed response to a disaster.

Findings

Although there has been some improvement in the availability of information about earthquake and tsunami hazards and risks in the past few years, many coastal residents, visitors, and even providers of emergency services are ill-informed about them. Not all understand what earthquakes are and what causes them. Many are not aware of the kinds of earthquakes that occur in the region or know the significance of the CSZ. Few know what to expect during and after each type of earthquake. And some who are aware of earthquake hazards may not understand that although they are likely to survive even a major earthquake, the community might be severely affected (for example, there will be many injuries, isolation in small groups, and damage to buildings, roads, bridges, dams, and utilities).

With respect to disaster preparedness, detailed information is available, mostly from federal agencies and the American Red Cross, covering such topics as preparation of emergency provisions, removing potential household hazards, and accessing emergency communication systems. What is lacking, however, is more regional information covering such topics as tsunami evacuation routes, areas deemed "safe" from catastrophic hazards, availability of local emergency services, and location of food and water. Whereas most general information deals with preparing for a catastrophic event, regional information is vital for the time during and immediately after just such an event.

Recommendations

Recommendation 16-1. Assign state leadership responsibility for earthquake and tsunami awareness, risk reduction, and preparedness and response education to DOGAMI, in partnership with the OEM. These agencies should integrate their efforts and make full use of other centers of scientific and technical expertise, financial support, and educational services. Among these centers are FEMA, U.S. Geological Survey, OSSPAC, the American Red Cross, local emergency management organizations, the State Fire Marshall, the Oregon State Police and local law enforcement agencies, the Department of Education and local school districts, higher education institutions, the OSU Extension Service, and the community college system.

Implementing Action for Recommendation 16-1

16-1. The Oregon State Legislature should designate DOGAMI as the lead state agency for earthquake and tsunami education, in partnership with OEM and other listed agencies, commissions, institutions, and organizations.

Recommendation 16-2

Assign local leadership responsibility for earthquake and tsunami awareness, risk reduction, and disaster response and preparedness education to county emergency management authorities. Base such education on a likely earthquake and tsunami scenario for each area, recognizing the critical role of local

The tsunamis that hit Crescent City, California, following the March 28, 1964 Alaskan earthquake claimed 11 lives and caused more than $7 million in damage (G. Griffin, Crescent City photo).

chapters of the American Red Cross, fire and police departments, medical providers, the Coast Guard, local OSU Extension offices, and other agencies, organizations, and auxiliaries.

Implementing Action for Recommendation 16-2

16-2. The Oregon State Legislature should designate county emergency management authorities as lead agencies for local earthquake and tsunami education, in partnership with DOGAMI, the American Red Cross, and other agencies.

Recommendation 16-3

Design and implement broad-based, sustainable educational programs focused on increasing awareness of earthquake and tsunami hazards and improving disaster preparedness and response. Target audiences are coastal residents and visitors, schools and youth, service providers, businesses and industry, developers and contractors, and financial and legal sectors.

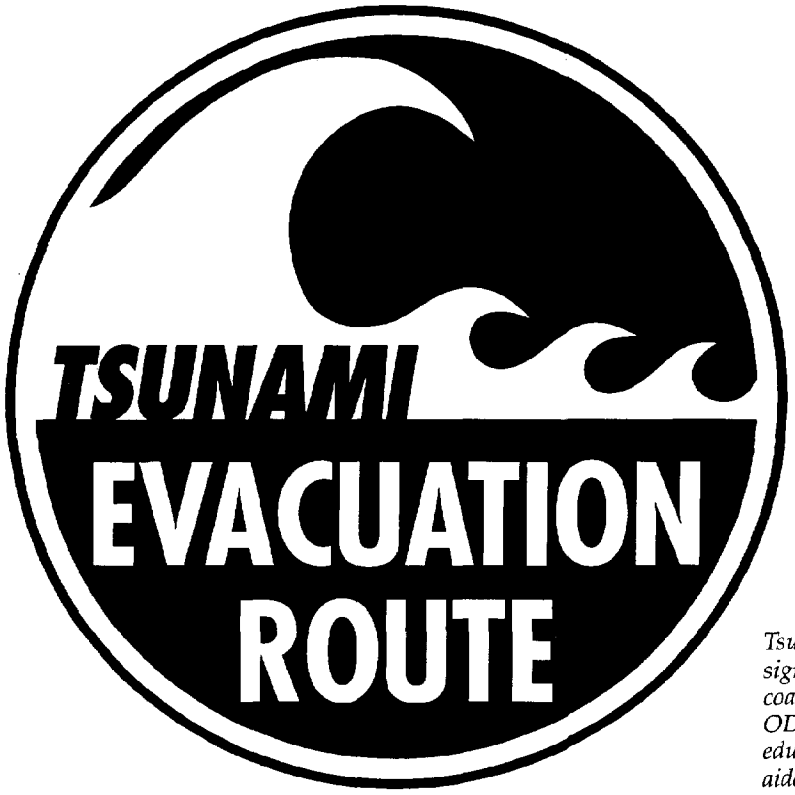
Implementing Actions for Recommendation 16-3

16-3 A. A preliminary framework for education programs is outlined in Recommendation 16-6 and in Appendix D, "Cascadia Earthquake—Tsunami Education Strategy." DOGAMI and OEM should take the lead in implementing this effort, in partnership with other agencies.

16-3 B. The Oregon Legislature should support the DOGAMI 1995 legislative initiative for tsunami hazard education in schools, but broaden both the audience coverage and topics to include other earthquake hazards along the coast, such as structural hazards caused by ground shaking, landslides, and liquefaction of soils. Other educational systems in the state—the Department of Education, the community college system, and the OSU Extension Service, including Sea Grant—should seek state and federal support to expand their education programs in this area.

Recommendation 16-4

Establish and participate in a Cascadia Earthquake—Tsunami Education Network in the region (Oregon, Washington, northern California, and British Columbia) to coordinate education activities, and share resources, materials, and know-how. Include educators,



Tsunami warning zone and evacuation route signs like these have been approved for use in coastal communities by DOGAMI and ODOT. The signs will serve both as an educational device and as a real-time response aide in the event of an earthquake or tsunami.

public and private educational institutions and organizations, and other interested individuals in the network.

Implementing Action for Recommendation 16-4

16-4. DOGAMI, OEM, and county emergency managers should organize the Oregon component of the proposed Earthquake-Tsunami Education Network and develop ties with appropriate agencies in Washington and California to develop components of the network in those states.

Recommendation 16-5

Identify, collect, catalog, and store existing earthquake and tsunami education materials at a statewide or regional clearinghouse. Disseminate this information to educators and others in the Cascadia region.

Implementing Action for Recommendation 16-5

16-5. Lead agencies should implement this recommendation through the proposed Cascadia Earthquake-Tsunami Education Network.

Recommendation 16-6

Identify outstanding educational materials and approaches from other areas (for example, from the California Office of Emergency Services). Tailor the material to specific audiences, learning styles, educational levels, and geographic areas of the Cascadia region. The following are examples:

a. a model educational package with videos, slide sets with text, fact sheets, a simulated earthquake experience, and preparedness-response demonstrations that could be tailored to specific audiences or areas

b. a Cascadia "speakers bureau" with regional experts on earthquake and tsunami hazards, techniques for reducing hazards in the home or office, preparing emergency kits, responding to disasters, and communicating after a disaster

c. earthquake media packets with response and survival information, specialist contacts, etc., that radio, television, print, and other media could use when an earthquake occurs

Implementing Action for Recommendation 16-6

16-6. DOGAMI, OEM, and county emergency managers should implement this recommendation through the proposed Cascadia Earthquake-Tsunami Education Network.

Issue 17

State and local emergency management plans do not adequately address the scope and scale of coastal earthquake and tsunami hazards and risks.

Emergency management plans for most coastal counties and communities do not adequately address earthquake, tsunami, and related natural hazards. The realization that the Oregon coast is susceptible to these types of hazards has been fully accepted only in the past decade. Most of the scientific data concerning the effects of such catastrophic events has been documented within the past few years and has not yet been fully accounted for in emergency management plans.

Findings

Disaster response efforts at the local level are coordinated by county emergency management staff and volunteers. Few county disaster response plans fully account for the range, severity, and distribution of destruction that would likely accompany a large CSZ earthquake and associated tsunamis. Neither do they deal adequately with the expected degree or length of isolation that may be experienced. This is in part due to the lack of area-specific information on what can be expected during a large earthquake. Getting the financial resources and political support to prepare such plans has also been a problem in some areas, in part because local officials do not want to overreact to the earthquake threat. Most communities are trying to prepare without unduly frightening residents and visitors. Quakex-94, a full-scale, state-wide exercise with a magnitude 8.5 CSZ earthquake and locally generated tsunamis, has provided state and local emergency managers additional information with which to upgrade their plans and develop earthquake annexes (an annex is an appendix of special procedures).

Recommendations

Recommendation 17-1

Require preparation of an earthquake annex to Oregon's all-hazards Emergency Operations Plan, based in part on what was learned in Quakex-94. At the state level, emphasize emergency relief hierarchy and procedures; reestablishment of basic services and lifelines, including power, communications, water and sewer services; and emergency repair of roads and bridges.

Implementing Action for Recommendation 17-1

17-1. The Oregon State Legislature should amend ORS 401 to require that OEM prepare a state earthquake annex, in collaboration with FEMA and other relevant federal, state, and local agencies. Appropriate funding should be provided as well.

Recommendation 17-2

Develop a model earthquake annex for coastal county emergency plans based on a detailed earthquake or tsunami scenario developed by DOGAMI. Provide technical assistance to counties and cities in adapting the model to their area. The model local earthquake annex should focus principally on caring for people but should assume that coastal jurisdictions will be isolated for a relatively long time following a large earthquake because they will be low on the priority list for receiving post-disaster aid from outside sources. A model earthquake annex should contain the following

a. an inventory of locally available equipment and supplies (including those in adjacent counties) that could be used during an earthquake disaster and a plan for mobilizing in event of an earthquake

b. an inventory of hazardous materials along with plans for making the sites earthquake-ready, if they are not already so

c. an inventory of critical facilities and service providers (for example, hospitals, schools, water treatment plants) and their susceptibility to earthquake damage

d. an inventory of residents or groups who may need special help during or after an earthquake

e. evacuation plans based on infrastructure that is expected to remain usable after an earthquake or a tsunami

Implementing Action for Recommendation 17-2

17-2. The Oregon State Legislature should amend ORS 401 to require that OEM prepare a model local earthquake annex, in collaboration with FEMA, DOGAMI, and other relevant federal, state, and local agencies. Appropriate funding should be provided as well.

Recommendation 17-3

Following the OEM model earthquake annex (developed as per Recommendation 17-2), counties, cities, and other organizations, as determined by counties, should develop earthquake annexes for their all-hazard emergency plans.

Implementing Action for Recommendation 17-3

17-3. Responsibility for development of local earthquake annexes should be vested in local emergency management organizations, with technical assistance from FEMA, OEM, and other emergency preparedness agencies.

Recommendation 17-4

Require that state and local earthquake annexes to emergency plans be peer reviewed periodically by a team appointed by OEM to ensure that they are kept up-to-date with the ever-expanding knowledge base on coastal earthquake hazards and mitigation strategies.

Implementing Action for Recommendation 17-4

17-4. The Oregon State Legislature should amend ORS 401 to require periodic peer review and update of state and local emergency operation plans. OEM should implement this provision, seeking assistance from the Oregon Emergency Managers Association.

Issue 18

Earthquake preparedness and response planning for businesses, families, schools, and individuals are inadequate.

Most businesses, schools, homes, and individuals are not well prepared for an earthquake or tsunami disaster. Few have instituted the full array of precautionary mitigation measures, have adequate emergency supplies stockpiled, and have written response plans that are regularly exercised.

Findings

Few homes and families have the plan of action needed to reduce the initial shock of an earthquake and to promote family self-sufficiency for at least 72 hours afterwards (or longer in the event of a large earthquake). Similarly, few workplaces have preparedness and response plans in place. Schools may have such plans, but few incorporate needed provisions, most are not adequately exercised, and few make needed links with family plans. In addition, most homes, schools, and workplaces have not conducted assessments of the structural integrity of their buildings and implemented needed retrofitting (see Issue 15); nor have they taken nonstructural mitigation precautions, such as measures to secure bookshelves, water heaters, hazardous materials, or other equipment or supplies.

Recommendations

Recommendation 18-1

Evaluate existing levels of disaster preparedness in homes, schools, and work places. Develop a strategy for making structural and nonstructural inspections and improvements and for distributing FEMA and Red Cross guides and brochures that explain how to prepare disaster response plans and supply kits, eliminate home hazards, and respond to an earthquake.

Implementing Action for Recommendation 18-1

18-1. Local emergency managers should implement this recommendation, with assistance from DOGAMI, OEM, local Red Cross offices, and other emergency management personnel in communities.

Recommendation 18-2

Use grassroots organizations such as community volunteer programs, neighborhood associations, and community planning organizations to contact and assist families and individuals.

Implementing Action for Recommendation 18-2

18-2. Local emergency managers should implement this recommendation, with the assistance of leaders in grassroots organizations.

Recommendation 18-3

Require school officials to develop and implement earthquake preparedness plans consistent with FEMA Bulletin 88 *(Guidebook for Development of a School Earthquake Safety Program)* and additional guidelines for tsunami evacuation, if applicable. The consequences of this planning are as follows:

a. students will have their own earthquake preparedness "ready kit" at school

b. students will know what their role is in both their family plan and the school plan and feel confident about their own safety and that of family members

c. school administrators will have a plan for what to do with school children after the earthquake

d. staff will have their own family emergency plans in place so they can concentrate on emergency duties at school

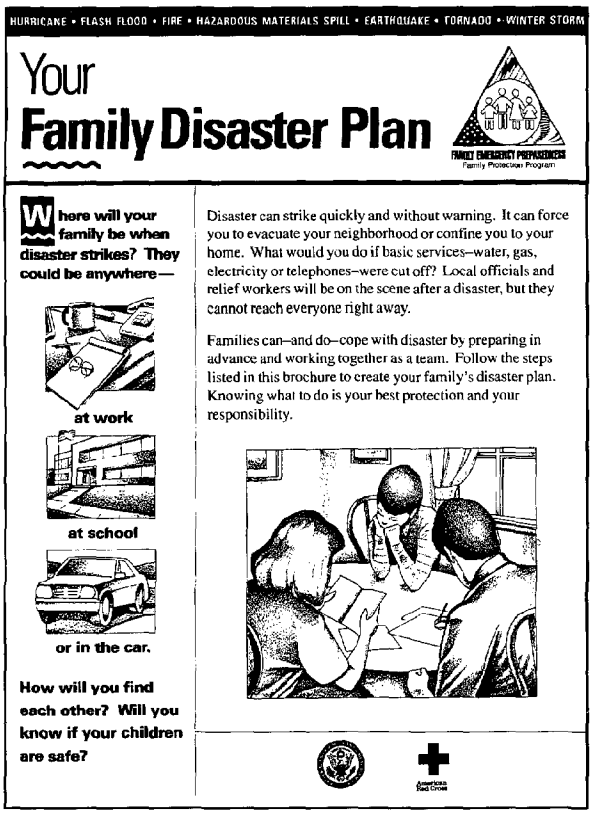
e. school safety personnel will

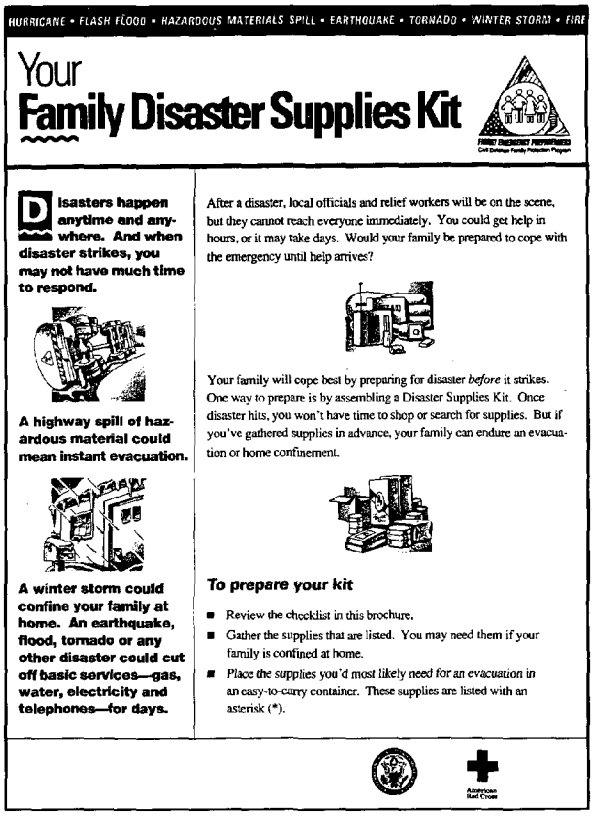
1) identify and mitigate structural and nonstructural hazards in their school

2) determine if their school is in a potential tsunami inundation area, and if so, have appropriate evacuation procedures in place

Implementing Action for Recommendation 18-3

18-3. The Department of Education, DOGAMI, OEM, and local school districts, with the support





Disaster response planning aides are available from the American Red Cross and FEMA.

of OSSPAC, should initiate needed legislative changes and implement them at the local school district level, in cooperation with county emergency management authorities.

Recommendation 18-4

Require that commercial or industrial businesses or public agencies that use or store hazardous materials on-site develop earthquake preparedness and response plans. Strongly encourage other businesses, particularly those with a large number of employees or customers (for example, motels and shopping centers) or those located in hazardous locations (for example, tsunami inundation zones), to prepare such plans.

Implementing Action for Recommendation 18-4

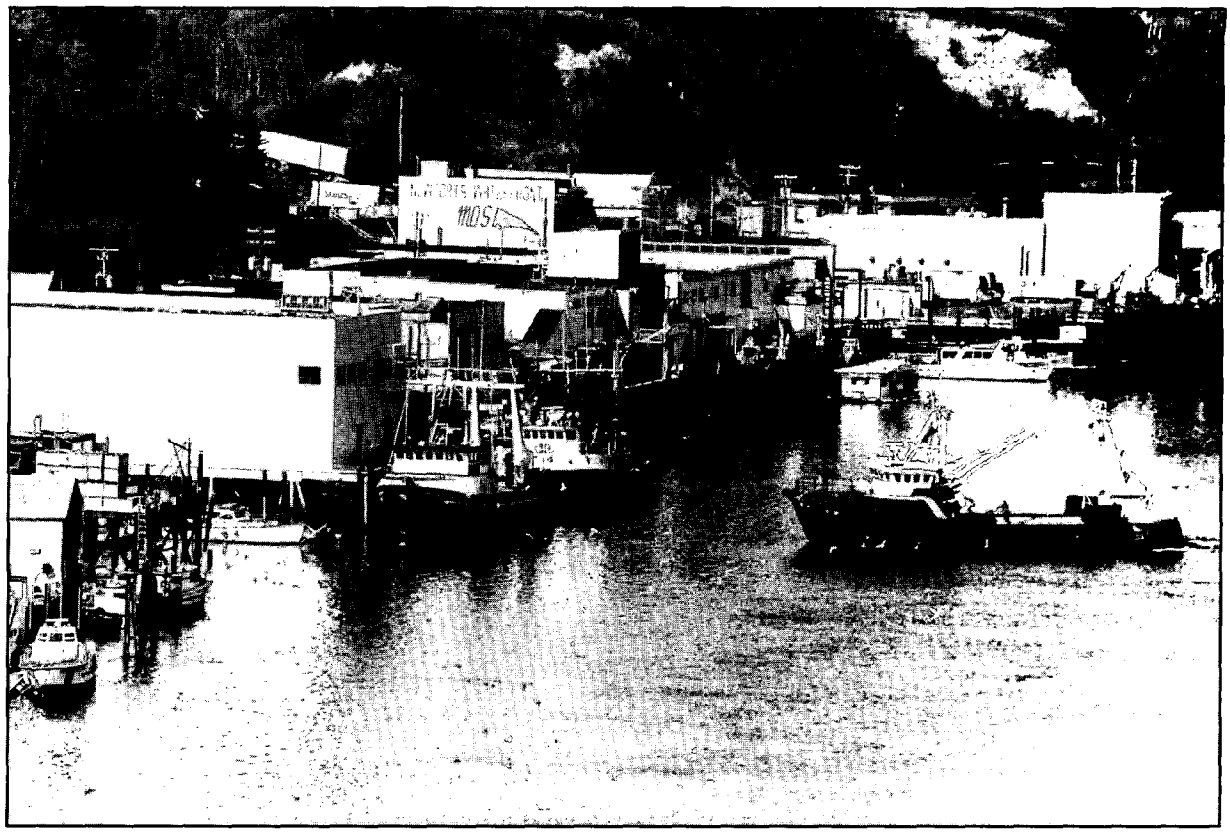
18-4. Local governments should implement this recommendation through an existing local business licensing process (or similar existing mechanism), providing new businesses and renewals with an "earthquake preparedness tool kit."

Recommendation 18-5

Develop emergency preparedness and response plans at Oregon coastal ports and other marine and waterfront businesses. These plans should emphasize tsunami hazards and evacuation (see also Recommendation 22-3).

Implementing Action for Recommendation 18-5

18-5. OEM, in collaboration with local emergency managers, ports, the Pacific Coast Congress of Port Managers and Harbor Masters, and Oregon, Washington, and California Sea Grant programs, should develop a model disaster preparedness and response plan for ports and waterfronts and conduct workshops on adaption of the model to local ports.



Port facilities and users along the coast are particularly vulnerable to tsunami hazards (T. Gentle photo).

Issue 19

The organizational structure for coastal emergency management is not fully implemented.

Although counties have overall coordination responsibilities for emergency management, relationships to state and federal emergency management authorities is unclear in some cases, and participation in the emergency management system by cities, rural centers, special districts, and essential service providers is inconsistent.

Findings

Although there is a hierarchical structure in county emergency management, no real command and control system is in place that could deal effectively with a major disaster like a CSZ earthquake. Some emergency managers are interested in dealing with the large earthquake scenario; others are not and are instead waiting for the state to enforce the mandate that was established by the 1993 state legislature (House Bill 3567). There is a limited leadership at the state level and in some counties; there is little interest or participation by some cities and other key entities; and there are few resources available to address the situation adequately.

Recommendations

Recommendation 19-1

In the event of a regional disaster, such as an earthquake, automatically place under the command of county emergency management authorities all cities, special districts, and other emergency service providers who do not have an emergency plan or who do not specify incident command relationships.

Implementing Action for Recommendation 19-1

19-1. OEM should develop and implement and enforce rules that place cities, special districts, and other local emergency responders under the command of county-level emergency managers.

Recommendation 19-2

Organize all local emergency responders using a command system that follows one of several available models (for example, Incident Command System [ICS] or the National Incident Management System [NIMS]). In the system selected, clearly define hierarchical relationships between counties, cities, special districts, essential service providers, private relief organizations, OEM, and FEMA.

Implementing Action for Recommendation 19-2

19-2. OEM should develop and implement rules that require county-level emergency managers to establish an effective and consistent command system, consistent with House Bill 3567 (ORS 401 amendments). To facilitate this improved emergency response organization, OEM should provide technical assistance to counties and other local emergency responders.

Issue 20

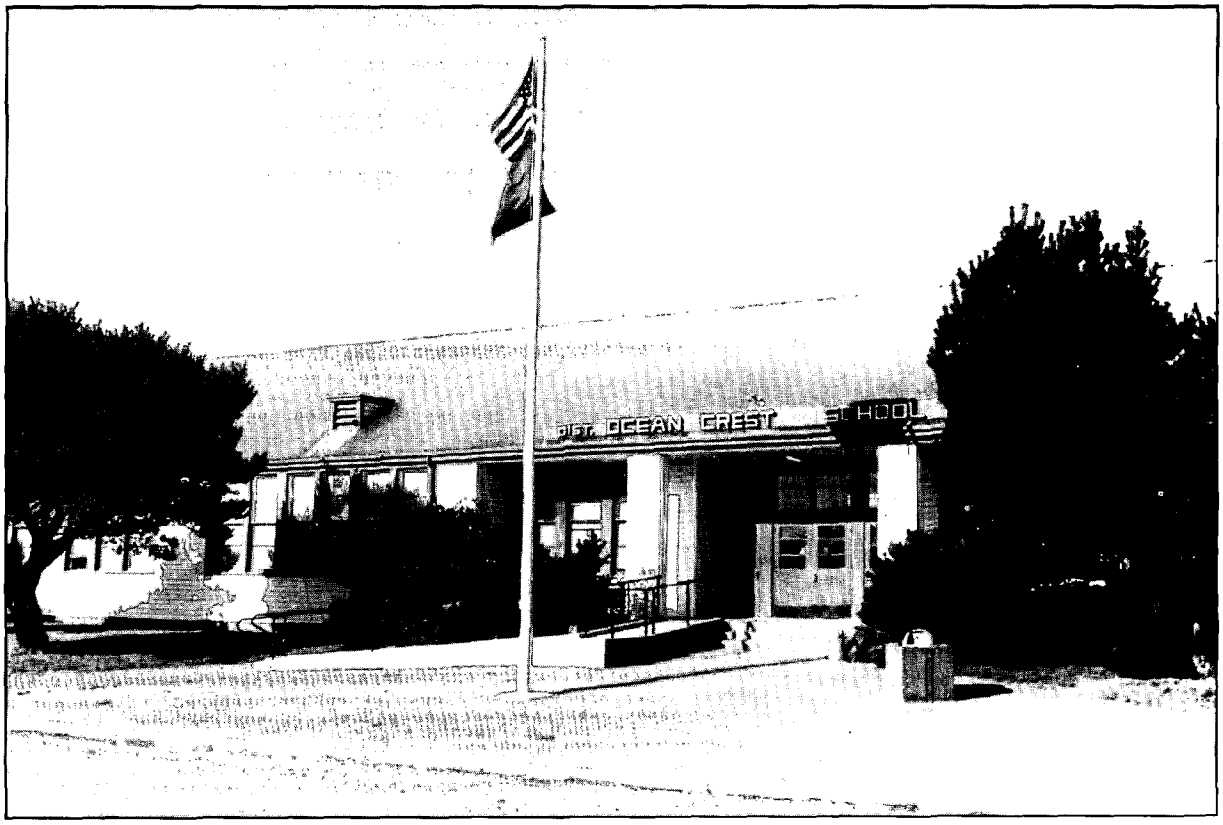
Local disaster response plans are not well exercised.

Communities with disaster response plans that deal with earthquakes have too few drills and exercises to test the plans for workability and needed improvements.

Findings

Although all counties and many cities, schools, and other groups have general emergency response plans in place, that fact does not ensure that residents, emergency responders, children, or employees will follow them or are even aware of them. The March 1993 Scotts Mill earthquake provided just such an example: in Clatsop County, where emergency managers have provided significant leadership for others along the Oregon coast, several residents of Cannon Beach wandered down to the beach approximately 30 minutes after the initial tsunami warning sirens had gone off. If this had been a CSZ earthquake, this is approximately when the first tsunami wave would have reached the shore.

Although drills and exercises cannot guarantee that all residents will follow emergency plans, holding such drills or exercises and emphasizing their importance can make residents and emergency service providers more aware of the hazards and the appropriate responses to them. In addition to simple drills, there are four types of exercises, listed in order of scale: orientation, tabletop, functional, and full scale (see glossary for definitions).



Schools, especially those vulnerable to tsunamis, should conduct regular earthquake and tsunami response drills (J. Good photo).

Recommendations

Recommendation 20-1

Require earthquake and tsunami (if applicable) response and evacuation drills. Keep for state review records that identify drills that had problems and describe how those problems were rectified. Require drills on the following schedule:

a. drills every two months for schools

b. annual drills for emergency response facilities, service providers, and other public buildings

Implementing Action for Recommendation 20-1

20-1. OEM should require such drills and record keeping and periodically review records. County emergency managers should ensure that such drills are conducted and that identified problems are rectified. For schools, county emergency managers should cooperate with school administrators and local school site councils (established under recent educational reforms) and observe such drills at least annually.

Recommendation 20-2

Require earthquake orientation or tabletop exercises annually. Consistent with available funding, require functional or full-scale exercises that focus specifically on earthquakes and tsunamis and their effects every four years.

Implementing Action for Recommendation 20-2

20-2. Local emergency management organizations, under the leadership of counties, should conduct such exercises, reporting results to OEM.

Recommendation 20-3

Establish an exchange program for emergency managers from Oregon to observe earthquake exercises occurring in other regions of the country. Have other states' emergency managers observe and critique exercises in Oregon coastal communities.

Implementing Action for Recommendation 20-3

20-3. OEM should implement an exchange program (in accordance with Recommendation 20-3), with the assistance of the Oregon Emergency Managers Association.

Recommendation 20-4

Local emergency management organizations should use nonemergency events such as parades and festivals to exercise and improve command, response, and coordination functions that will be essential in the event of an earthquake or similar disaster.

Implementing Action for Recommendation 20-4

20-4. Local emergency facilities and service providers, under the leadership of counties, should use such nonemergency situations for emergency response preparedness as such situations arise. They should coordinate improvements with county emergency managers.

Issue 21

Communication networks are insufficient to deal with a large earthquake.

Traditional public communication networks will be incapacitated at the time of a large CSZ earthquake and for a long time thereafter. Sufficient emergency communication networks are not in place to fill the void.

Findings

All communication networks will be affected by a large earthquake. Telephone lines will likely be out for a long period. Television stations will likely be out unless adequate backup power is available; generally, it is not. Radio stations will be off the air unless they have backup emergency power generators that work. This is also true of stations that are part of the nationwide emergency broadcasting system. HAM radio operators will enable critical service providers (fire, police, medical, etc.) to keep in touch with the incident command headquarters, but they will not provide the broad communication link that is needed to warn people of hazards and prevent chaos in the community. Improved cellular phone technology is coming slowly to Oregon coastal regions.

Structures and equipment in government communication centers and other facilities required for emergency response, such as the emergency broadcasting system, are "essential facilities" as defined by ORS 455.447. See Recommendations 15-1 and 15-2 for additional policy initiatives regarding these facilities.

Recommendations

Recommendation 21-1

Establish community low-power radio networks for the dissemination of public emergency information during and after a large earthquake.

Implementing Action for Recommendation 21-1

21-1. County emergency mangers should help implement low-power radio networks for communities within their jurisdiction, in cooperation with nonemergency users, such as Chambers of Commerce (for tourist information), local Extension Service offices, etc.

Recommendation 21-2

In cooperation with an officially designated radio or television station, evaluate the emergency broadcasting system in each coastal region; on the basis of the outcome, make the system fully operational. In addition, ensure (1) that emergency broadcast stations are well protected against physical damage caused by a potential catastrophic event, (2) that station personnel are well prepared and versed in proper emergency procedures, and (3) that other stations, if still operational after a disaster, simultaneously broadcast the same information as that sent by the designated emergency broadcasting stations.

Implementing Action for Recommendation 21-2

21-2. OEM, as operator of the state emergency broadcasting system, should conduct the recommended evaluation of the system, in cooperation with county emergency management organizations.

Recommendation 21-3

Establish uniform and effective tsunami warning systems using siren and voice communication in coastal communities and vulnerable rural centers that lack them. Ensure that citizens and visitors are aware of the system by publishing information in phone directories and other local publications and by requiring postings at public places, restaurants, rental units, and motels.

Implementing Action for Recommendation 21-3

21-3. Local emergency management organizations, with assistance from county, state, and federal emergency managers, and from the National Oceanic and Atmospheric Administration—Pacific and Alaska Tsunami Warning Centers, should fund and implement tsunami warning systems and notifications. Local ordinances should be used to enforce such notification procedures.

Recommendation 21-4

Review the structural integrity (that is, the ability of a system to withstand a catastrophic earthquake) of all parts of state and county emergency communication systems and infrastructure, and retrofit where needed (see also Recommendations 15-1 and 15-2).

Implementing Action for Recommendation 21-4

21-4. See Implementing Actions 15-1 and 15-2.

Recommendation 21-5

Establish recovery teams to evaluate communication systems after an earthquake and to make them fully operational.

Implementing Action for Recommendation 21-5

21-5. County emergency managers should identify local communication systems recovery teams, include this information in their emergency operations plans, and provide for their training and exercising.

Recommendation 21-6

Establish contingency plans to organize local postdisaster communication networks among HAM radio, marine radio, CB radio, and other informal communication systems (such as low-power radio) as an adjunct to the formal communication system.

Implementing Action for Recommendation 21-6

21-6. County emergency managers should identify local postdisaster communication networks, include this information in their emergency operations plans, and provide for network training and exercising.

Recommendation 21-7

Establish emergency communication systems within schools, using, for example, walkie-talkies (see FEMA Bulletin 88, *Guidebook for Development of a School Earthquake Safety Program*).

Implementing Action for Recommendaion 21-7

21-7. Schools, with assistance from local emergency managers and school site councils, should implement such a system.

Issue 22

Physical infrastructure, lifelines, and utility systems will be severely disrupted in the event of a large CSZ earthquake.

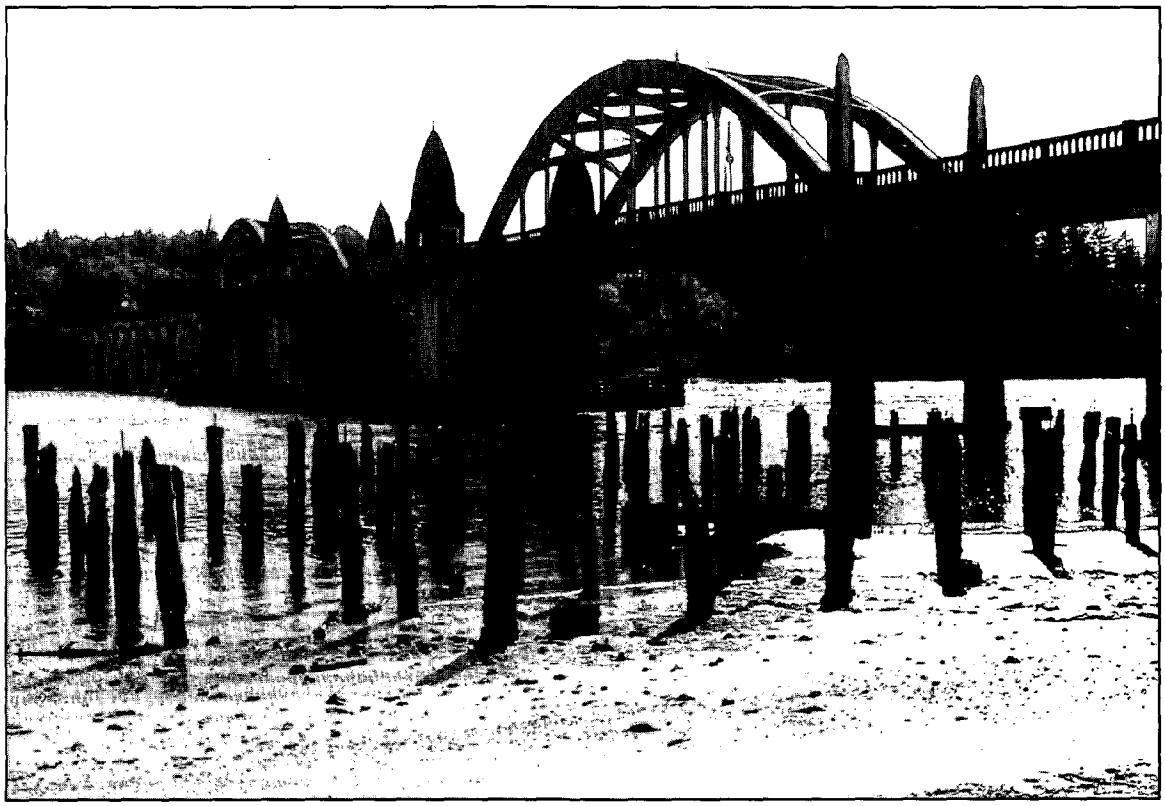
Transportation systems—highways, bridges, railroads, ports, waterways, and airports—are likely to be severely damaged by a CSZ earthquake and the tsunamis that follow. Utilities, including water, sewer, and gas lines, and other lifeline and communication systems will be similarly disrupted.

Findings

The severe ground shaking, liquefaction, landslides, flooding, and tsunamis associated with a large CSZ earthquake will likely affect the entire coastal zone. The physical infrastructure that connects affected areas to their supplies of basic necessities will be greatly disrupted by a disaster. Transportation by land will obviously be hindered. North-south and east-west highways will be severed by slides. Many bridges will be destroyed or become impassable. Rail lines will also be cut, removing a major route for disaster aid.

Other modes of transport will also be affected. Harbors and waterways will be filled with debris and disabled vessels, making them unusable. Most airport runways will become unsafe for air transport.

Utility and communication systems will also be destroyed or disrupted. Water supplies may be cut off or be made unpotable, and water storage facilities, including dams, may fail. Electricity and gas will be cut off, creating fire and explosion hazards as well. As a result of these disruptions, coastal residents and visitors could be isolated in small clusters up and



Many older bridges along the coast, such as this one at Florence, would likely be severely damaged by a large CSZ earthquake (J. Good photo).

down the coast and will need to survive without outside aid for 3 to 10 days and possibly longer.

Recommendations

Recommendation 22-1

Evaluate highways, roads, bridges, airports, harbors, and railroads for their vulnerability to earthquake or tsunami damage, using existing geologic information and a credible CSZ earthquake scenario. Publish and distribute the results of the evaluation, identifying transportation infrastructure likely to be damaged, the infrastructure that would be most easily restored, and the areas likely to be isolated after a large CSZ earthquake. Also provide an estimated timetable for re-establishment of transportation infrastructure in coastal communities based on likely scenarios.

Implementing Action for Recommendation 22-1

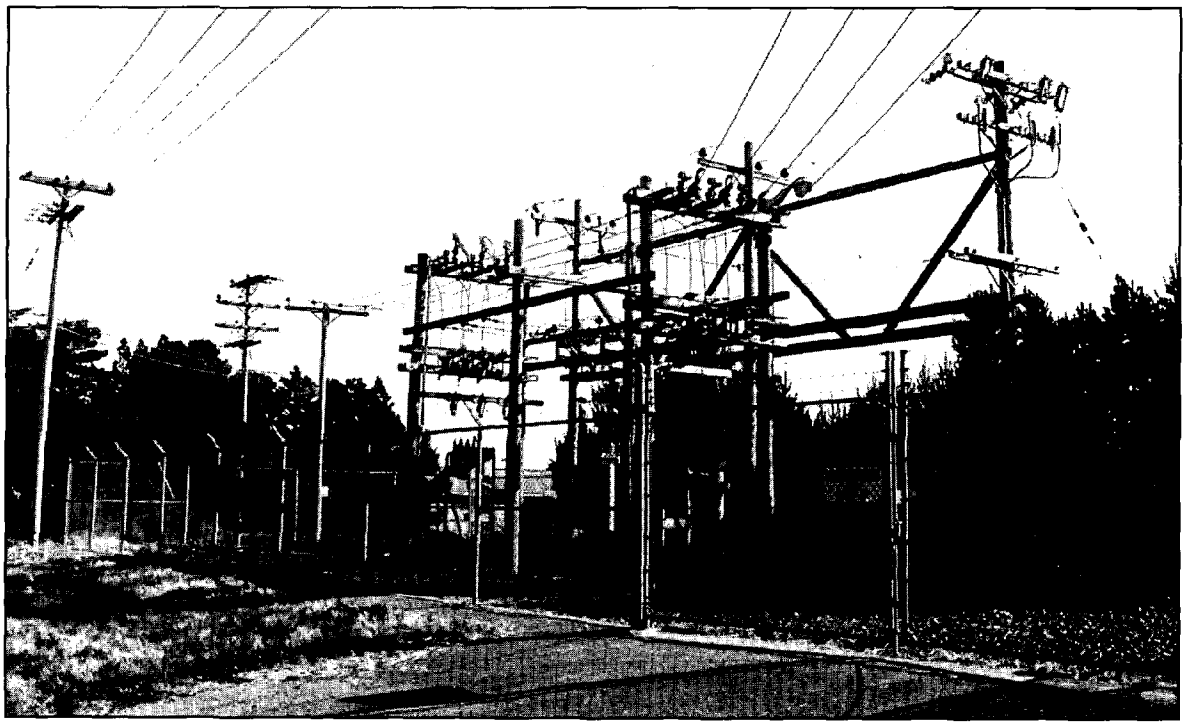
22-1. The Oregon Department of Transportation (ODOT), in cooperation with the U.S. Forest Service, the Bureau of Land Management, USACOE, counties, cities, and railroad companies, should undertake the transportation infrastructure evaluation described in Recommendation 22-1.

Recommendation 22-2

Evaluate utilities, including water (and all types of dams), sewer, electricity, and gas systems and pipelines for their vulnerability to earthquake damage, using existing geologic information and a credible CSZ earthquake scenario. Publish and distribute the evaluation results, identifying utilities and associated infrastructure likely to be damaged during a large earthquake. Also provide an estimated timetable for re-establishing utility services to coastal communities based on likely scenarios.

Implementing Actions for Recommendation 22-2

22-2 A. The Oregon Public Utility Commission, in cooperation with public and private utilities, the Oregon Water Resources Department, county emergency management authorities, cities, and special utility districts, should undertake the utility infrastructure evaluation described in Recommendation 22-2.



Electrical power substations are one of the most vulnerable components of the power generation and delivery system (J. Good photo).

22-2 B. *For dams, the Oregon Water Resources Department should evaluate and update its inventory of dams, map all coastal dam sites with vulnerability ratings, and develop quick dam-failure inundation maps and downstream notification procedures.*

Recommendation 22-3

Evaluate the vulnerability of coastal ports to seismic hazards and tsunamis. Develop appropriate disaster preparedness and response plans for ports to address the varying levels of a potentially catastrophic event (see also Recommendation 18-5).

Implementing Action for Recommendation 22-3

22-3. *OEM, in collaboration with ports, local emergency managers, USACOE, FEMA, the Pacific Coast Congress of Port Managers and Harbor Masters, and Oregon, Washington, and California Sea Grant Programs, should develop a model disaster preparedness and response plan for ports and waterfronts and conduct workshops on adapting the model to local ports and associated waterfront businesses.*

Recommendation 22-4

Require continuing education on structural codes and design standards for seismic and tsunami-prone areas for designers, engineers, architects, contractors, and building officials working in coastal areas.

Implementing Action for Recommendation 22-4

22-4. *Appropriate licensing boards should add such requirements to their qualifications and licensing and license renewal processes.*

Issue 23

Coastal communities do not have postdisaster recovery and reconstruction plans in place.

Long-term recovery from a major CSZ earthquake will require the rebuilding of cities and towns and the infrastructure that supports them. At present, state agencies responsible for infrastructure, principally the Department of Transportation, do not have postdisaster reconstruction plans. Neither do cities and counties, who have responsibility for regulating development and reconstruction at the local level.

Findings

A large CSZ earthquake may destroy a significant percentage of the buildings in coastal communities, as well as much of the public and private infrastructure that ties them together and connects them with other communities. Reconstruction of buildings and associated infrastructure will be a massive, long-term undertaking requiring a great deal of financial aid, planning, technical assistance, and cooperation among agencies and the public. Although tragic, such a disaster will also present communities with an opportunity to physically redesign and reshape themselves, creating safer places for people to live and work. However, no attention has been given to planning for reconstruction after a disaster. In the absence of a viable decision-making framework for such reconstruction, restoration could be delayed or carried out in a haphazard manner and would be more costly in both the short and long term.

Recommendations

Recommendation 23-1

Develop postdisaster reconstruction plans based on damage projections from a CSZ earthquake and tsunami. Establish a state postdisaster planning and recovery task force to plan for reconstruction and serve as the lead state coordinating body to oversee postdisaster reconstruction. Membership of the task force should include DLCD, ODOT, DOGAMI, OSSPAC, OEM, the State Fire Marshall, and other relevant agencies. The task force would have the following responsibilities:

a. develop a state-wide damage classification scheme to delineate potential damage zones and determine the potential magnitude, types, and causes of damage based on DOGAMI hazard maps

b. review assessments of damage to transportation and utilities and determine priorities and a schedule for reconstruction, using as a guide:

   1) Priority I: essential transportation facilities; other essential facilities, hazardous facilities, major structures, and special occupancy structures (in accordance with ORS 455.447)

   2) Priority II: other structures and facilities requiring minor repairs

   3) Priority III: other structures and facilities requiring major repairs

   4) Priority IV: new construction

c. help local jurisdictions develop a plan for building, demolition, salvage, and debris removal and develop other features of local plans as needed

Implementing Action for Recommendation 23-1

23-1. OSSPAC should conduct a more thorough study of this issue, considering this recommendation as a beginning point. After the study, OSSPAC should make appropriate recommendations to the Oregon State Legislature, including a mandate for the necessary level of planning for postdisaster reconstruction.

Recommendation 23-2

Develop postdisaster reconstruction plans for cities and counties based on damage projections from a CSZ earthquake and tsunami. Establish city and county task forces to plan for reconstruction and oversee local postdisaster reconstruction activities. Assign to each task force a structural engineer, a sanitarian, a fire marshal, a geologist, an engineering geologist, a civil engineer, an emergency manager, and

building officials. The task force should have the following responsibilities:

a. establish local teams and direct them to assess damage from the disaster, using the state-prepared damage classification scheme, and to evaluate postdisaster hazard zones

b. review local damage assessments and determine priorities and schedule for reconstruction, using the following as a guide:

   1) Priority I: essential facilities, hazardous facilities, major structures, and special occupancy structures (in accordance with ORS 455.447)

   2) Priority II: other structures and facilities requiring minor repairs

   3) Priority III: other structures and facilities requiring major repairs

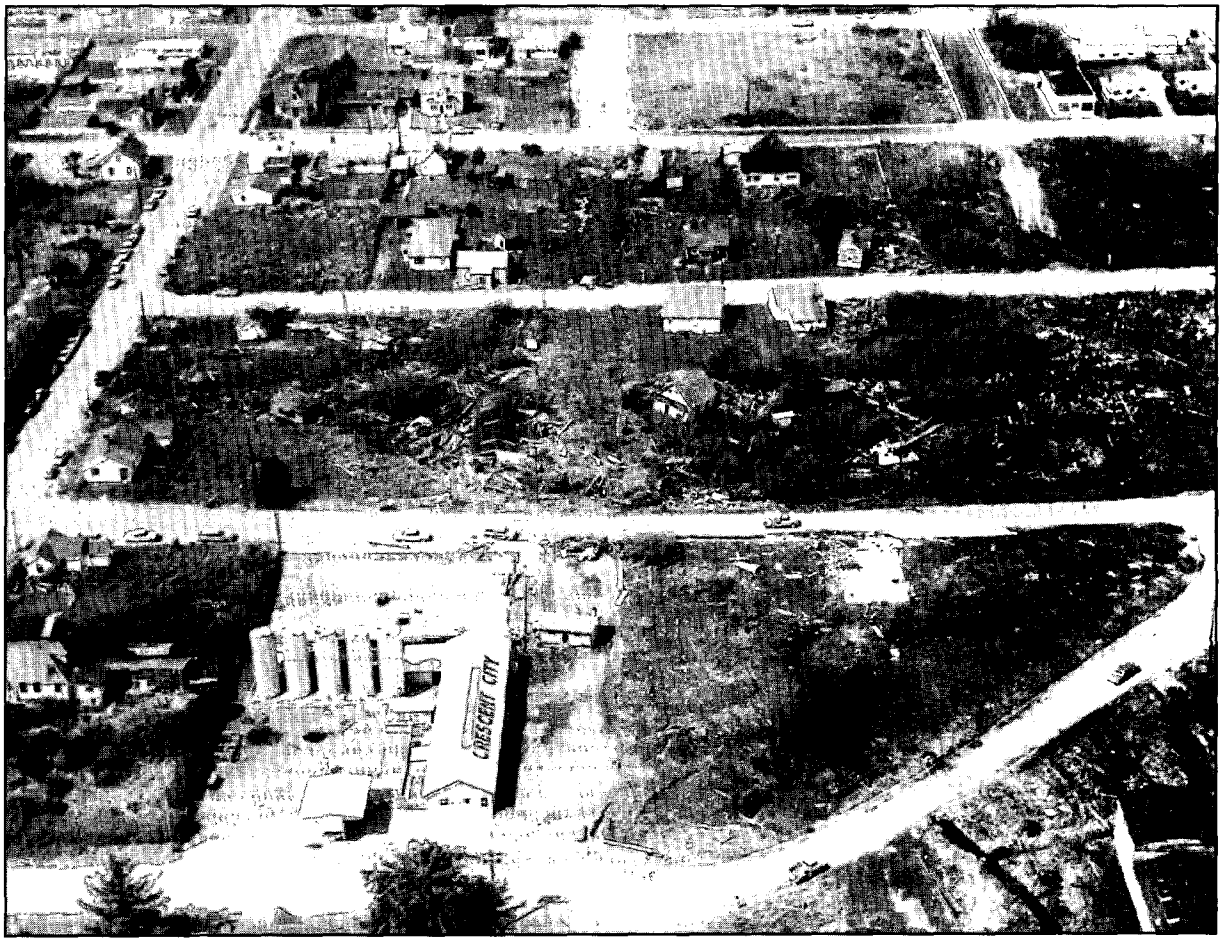
   4) Priority IV: new construction

c. establish limitations, standards, and approval procedures for reconstruction and implement postdisaster construction moratoria as needed

d. develop a plan for construction, demolition, salvage, and removal of debris

Implementing Action for Recommendation 23-2

23-2. As with Recommendation 23-1, OSSPAC should further evaluate needs in this area, including the necessary local government actions.



Where and how redevelopment would occur was a hot topic in Crescent City, California, following the tsunami generated by the March 28, 1964 Alaskan earthquake (G. Griffin, Crescent City photo).

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Appendices

Appendix A

Coastal Natural Hazards Policy Working Group Members and Coordination Team

Members

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Appendix B
Glossary of Terms and Acronyms

Terms

amplification—a numerical factor that describes the intensification of ground acceleration or shaking in an earthquake; for example, certain unstable soils will amplify groundshaking

annex—a special addition or addendum to a document, such as an earthquake annex to an all-hazards emergency operations plan

bathymetric—of or pertaining to the measurement of depths in oceans, seas, estuaries, or other large bodies of water; also the bottom contour of such waters

beach zone line—a surveyed line along Oregon beaches that approximated the vegetation line in 1967; the survey was commissioned by the legislature in the 1967 Beach Law and corresponds to the upland limit of State Parks and Recreation Department regulatory jurisdiction for beach improvements, shore protection structures, etc.

bulkhead—a type of seawall, usually constructed of wood, that protects the shore from waves and provides for upland slope stability

Cascadia—the coastal and inland region adjacent to the Cascadia subduction zone, generally extending from Cape Mendicino, California, to the northern extent of Vancouver Island, British Columbia

emergency operations plan—a formal, government-adopted emergency plan that details the operation of an all-hazards approach to disaster response, including fire, earthquake, tsunami, windstorm, hazardous material spill, flood, radiological release, etc. It is an approach that addresses emergency communication, evacuation, alert and warning, shelter and feeding, health and sanitation, medical response, transportation, and public information

fee simple—a kind of property ownership that is virtually absolute and includes the entire bundle of rights normally associated with private property, subject to governmental restrictions

footprint—with respect to buildings and building plans, the outline of the foundation of the structure on the ground

full-scale exercise—an emergency response activity intended to evaluate the operational capability of emergency management systems in an interactive manner over a significant time period

functional exercise—an emergency response activity designed to test or evaluate the capability of an individual to function, or a complex activity within a function

geodetic—pertaining to the science that deals with the shape, area, and curvature of the earth, with precise mapping of land elevations and locations

hazard mitigation—any action designed to lessen the threat natural hazards pose to human life or property; examples are limitations or restrictions on development, building construction setbacks, relocation of buildings, dune building and vegetative stabilization, and seawalls and revetments

Incident Command System—also known as ICS, this is a "first-in-response" system that activates all other response groups in the event of an emergency; the lead agency then continues as the command and coordination center throughout an emergency. For example, in the event of a disaster such as an earthquake, the county emergency operations center would take control

jetty—massive, constructed rock structures built to stabilize and protect harbor entrances, usually built perpendicular to the shore to stabilize a river mouth

liquefaction—the transformation of unconsolidated sediment (e.g., sand, silt, mud) from its solid state into a liquified state as a result of seismic waves passing through and destabilizing the sediments

littoral—of or pertaining to the shore, especially the ocean shore

littoral cell—a shoreline segment or reach that is bounded in a longshore direction by physical features such as a headland or jetty that limits or blocks longshore sand transport. A littoral cell extends seaward to a depth where beach-nearshore sediment exchange ceases (about the 60 ft depth contour along the Oregon coast) and inland to the point where there is no beach-shoreland sediment interaction. The sediment budget within each of Oregon's 22 distinct littoral cells encompasses a complete cycle of supply, storage and transport, and ultimate loss of sediment from the coastal environment.

National Incident Management System—also known as NIMS, this is a "first-in-response" system that activates all other response groups in the event of an emergency; it is similar to ICS.

ocean shore—in Oregon, the land lying between extreme low tide of the Pacific Ocean and the line of vegetation as established and described by ORS 390.770

orientation seminar—an emergency response activity that is an orientation to a local or state plan, procedure, organization, or response strategy, bringing together those with particular roles

overhang—with respect to buildings and building plans, the parts of a structure that extend beyond the building foundation footprint.

riprap revetment—sloping structures (typically 1V:1.5H or greater) built to protect existing land or newly created embankments against erosion by wave action, nearshore currents, or weather. Riprap refers to the large, erosion-resistant quarry rock commonly used to construct these structures, though other materials may be used. Typical revetments include a graded rock bedding or fabric filter layer, overlain by armor stones; a toe trench dug down to bedrock or the water table to prevent undermining when the beach is lowered by erosion; and often, a covering layer of sand planted with beach grass.

wave run-up—the swash of ocean waves as they impinge on the beach. Run-up has three principal components: (a) wave set-up, which is the super-elevation of mean water level above the still-water level of the sea; (b) fluctuations of the swash of individual waves about that mean; and (c) other swash oscillations of longer period than normal ocean waves.

seawall—a vertical or near vertical structure, or a stepped series of such structures, made of concrete, wood, steel or some combination thereof, designed to prevent landsliding or control wave-induced erosion (includes bulkheads and retaining walls)

seiche—the nontidal, oscillatory rise and fall of water in enclosed or partially enclosed lagoons or bays that may be generated by earthquakes

setback—in building construction, the horizontal distance measured from a hazardous zone (e.g., receding bluff face) to the first physical structure on the land; generally based on recession rate or other factors

subduction—the process of one crustal block descending beneath another, by folding or faulting or both

subduction zone—an extended region of subduction, as along the Cascadia subduction zone, where the Juan de Fuca oceanic plate subducts under the North American plate

subsidence—sinking or downward settling of the earth's surface; along the coast during an earthquake, subsidence may be rapid and occur over a large area, resulting in permanent flooding of low-lying areas.

sunset clause—a provision in a law or policy that limits the time period that an action, report, or policy is in effect and valid.

tabletop exercise—an activity in which elected and appointed officials and key agency staff are presented with simulated emergency situations without time constraints for action

tilt-up structures—buildings constructed of prefabricated slabs, usually concrete, that are tilted up to fit in place to form the sides or roofs of structures; unless very well tied together and reinforced, such structures may collapse during severe ground-shaking associated with earthquakes.

tsunami—a series of travelling waves of extremely long length and period, generated by disturbances associated with earthquakes below or near the ocean floor, submarine landslides, or volcanic eruptions (also called seismic sea waves and, popularly, tidal waves). Tsunamis may reach enormous dimensions, steepening and increasing in height as they approach shallow water, inundating low-lying areas, and where submarine topography is steep, breaking and causing great damage.

turbidity current—a type of bottom current on continental slopes and rises caused when a sediment-covered submarine slope becomes unstable and begins to collapse under its own weight or stirred into suspension in the overlying water. The sediment creates a water mass of higher density which flows downslope, gaining speed and flushing out submarine canyons and filling up the abyssal plains.

unreinforced masonry structure—also known as URMs, these are buildings constructed of bricks, concrete, or other masonry products that are not tied together with reinforcing steel attachments; such structures may collapse during severe ground-shaking associated with earthquakes.

Acronyms

BCD	Building Code Division, Oregon Department of Consumer and Business Services
CSZ	Cascadia subduction zone
DLCD	Department of Land Conservation and Development
DOGAMI	Department of Geology and Mineral Industries
DSL	Division of State Lands
FEMA	Federal Emergency Management Agency
ICS	Incident Command System
LCDC	Land Conservation and Development Commission
NIMS	National Incident Management System
ODOT	Oregon Department of Transportation
OEM	Oregon Emergency Management Division
OPRD	Oregon Parks and Recreation Department
ORS	Oregon Revised Statutes
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
PWG	Policy Working Group (for coastal natural hazards)
SAMP	special area management plan
SPS	shore protection structure
USACOE	U.S. Army Corps of Engineers

Appendix C
Coastal Natural Hazards Policy Working Group

Process and Meeting Schedule

The long-term goal of the Coastal Natural Hazards Policy Working Group (PWG) was to develop a specific set of recommendations to improve the management of natural hazards along the Oregon coast. The focus of the group's work was on measures that will reduce the potential for loss of life and property and protect valuable recreational and natural resources. Implementation of recommended measures are likely to include major roles for both the public and private sectors.

Keyed to the PWG process, below is a list of actual PWG meetings and related workshops, along with the topics covered.

1992

Stage I—Identifying Issues and Alternative Solutions (Options)

Using the "all-hazards/all-decisions matrix" as the basis for its process, the PWG identified problems and opportunities associated with each set of hazards/decisions, and then generated ideas for dealing with them. *Hazards* examined included chronic hazards, such as erosion, flooding, and potentially catastrophic hazards, such as earthquakes and tsunamis. Examples of *decisions* examined included locating private development and public infrastructure, designing buildings, protecting oceanfront development, and providing emergency services. As each set of hazards-decisions was discussed, a "working list" of issues and potential solutions identified by the PWG was grouped into categories. The product of Stage I of the process was a working list of issues and options for coastal natural hazards management.

Mar 20	Introductory Workshop: Process, schedule, expectations, concerns
May 14	Chronic Hazards: Locating Private Development in Undeveloped Areas
Jun 17-18	Chronic Hazards: Locating Private Development in Undeveloped Areas & Protecting Private Development in Undeveloped Areas Technical Advisory Committee Meeting: All-hazards mapping
Aug 19-20	Chronic Hazards: Protecting Private Development in Undeveloped Areas & Locating Private Development in Infill/Developed Areas
Sep 23-24	Chronic Hazards: Locating Private Development in Infill/Developed Areas & Locating Public Infrastructure/Facilities in Undeveloped, Infill, and Developed Areas Technical Advisory Committee Meeting: Catastrophic hazards scenario
Oct 21-22	Catastrophic Hazards: Locating Private and Public Development and Infrastructure in Coastal Areas Technical Advisory Committee Meeting: All-hazards mapping
Nov 18-19	Catastrophic Hazards: Locating and Designing Private and Public Development and Infrastructure
Dec 16-17	Catastrophic Hazards: Designing Private and Public Development/Infrastructure & Emergency Management/Post-disaster Reconstruction

1993

Jan 20-21	Catastrophic hazards: Emergency Management and Post-disaster Reconstruction Planning

Stage II—Evaluate Feasibility/Workability of Alternatives (Options)

Through public meetings/workshops, facilitated decision-making sessions, and the support of a writing team, the PWG produced 1) an Issues and Options Report, and 2) a final recommendations report.

Feb 17-18	PWG Issues and Options Report Small Group Selection/Work: Hazard Assessment; Disaster Preparedness and Response; Land Use; Shore Protection
	PWG/Education Advisory Committee Joint Workshop
Mar (various)	Meetings of small works groups
Apr 21-22	PWG Issues and Options Report Small Group Work
May (various)	Meetings of small works groups
Jun 16-17	PWG Issues and Options Report Small Group Selection/Work Options Evaluation Guidelines Development
Jul (various)	Meetings of small works groups
	Writing Team: Prepare Issues and Options Report and review process/evaluation framework
Aug (various)	Meetings of small works groups (same tasks as July)
	Writing Team: Prepare Issues and Options Report and review process/evaluation framework
Sep 22-23	1) Review/approve Issues and Options Report
	2) Review/approve review process
	3) Select groups for presentations and workshops
	4) Review public meeting materials and workshop format
Oct	Public Review Meetings
Nov	Public Review Meetings

Stage III—Recommend Policies/Needed Actions

Dec 1-2	PWG meeting: Review public input and begin decision-making on final recommendations
Dec 15-16	PWG meeting: Continue work on final recommendations

1994

Jan 19	PWG meeting: Continue work on final recommendations
Feb 16	PWG meeting: Continue work on final recommendations
Mar 17	PWG meeting: Continue work on final recommendations
Apr	Writing Team: Prepare first draft of final recommendations report
May 19-20	PWG meeting: Review, critique, approve first draft of final recommendations report
Jun-Sep	Writing Team: Complete final recommendations report, send to PWG for final review, and prepare for publication
Oct-Dec	Present recommendations to state legislators, local governments, boards and commissions, state agencies, and private groups as appropriate. Work toward implementation of recommendations.

Appendix D

Cascadia Earthquake-Tsunami Education Strategy (DRAFT)

Introduction

There is a growing awareness in the Pacific Northwest that the region is more seismically active than previously thought, that the risks from earthquakes to life and property are great, and that we as a region are largely unprepared. Three types of earthquakes pose the greatest threats:

1) shallow crustal quakes along active faults up to magnitude 6.5
2) intraplate quakes up to magnitude 7.4 that occur deep within the oceanic Juan de Fuca plate as it bends under the North American plate
3) very large Cascadia subduction zone (CSZ) quakes of magnitude 8-9+ that occur at the plate boundary offshore where the two plates are locked together

Oregon has recently been hit by two crustal quakes, the Scotts Mill quake (magnitude 5.6) that occurred March 25, 1993 and the Klamath Falls quake (magnitude 5.9) that occurred September 20, 1993 . Despite their relatively small size and rural epicenters, both caused significant property damage. Several intraplate events have occurred this century, including a M 7.1 event in the Puget Sound region, and the M 6.3 Port Orford earthquake in 1963. While there have been no historic CSZ earthquakes, there are several converging lines of evidence that suggest such an event may occur in the not-too-distant future. These include geodetic measurements of accumulating strain correlated with tide gauge data from a variety of coastal locations; sequential dating of abruptly submerged peat deposits in salt marshes all along the coast; records of offshore turbidity current deposits; and the archeological record. The evidence suggests the last large quake was about 300 years ago. The scenario for a CSZ event includes severe groundshaking that could last from one to four minutes; liquefaction of saturated, unconsolidated soils; numerous and possibly massive landslides; and a series of tsunami waves beginning to arrive soon after the event.

We are not well-prepared for the least of these quakes, let alone a potentially catastrophic CSZ event. Much can and likely will be done to increase earthquake resistance of new structures, to retrofit old buildings, and to institute new land use mitigation for the siting and relocation of certain critical structures and facilities. However, probably the most significant strategy to reduce injuries and loss of human life is the implementation of a comprehensive, coordinated public education program. A good deal of education on these and related issues is already being conducted and/or supported by the Red Cross, the Federal Emergency Management Agency (FEMA) and their state counterparts, the U.S. Geological Survey, public schools, and other state and local agencies and organizations. More needs to be done to integrate these efforts, share resources, develop new educational materials, or adapt existing media from elsewhere to the situation in the Pacific Northwest. Increased awareness is especially needed of the seismic risk and how to respond to the large tsunamis (seismic sea waves) that would likely be associated with a CSZ earthquake. Tsunami waves would probably be the source of the greatest number of casualties from a large CSZ earthquake.

The Cascadia Region Earthquake Education Strategy outlined below is a first attempt at developing region-specific objectives and strategies for earthquake hazard *awareness*, and for *preparation and response*. The approach taken to develop the strategy was a simple one. First, key individuals in education, government, and the private sector were invited to participate in a planning process. The process included the following steps:

Step 1—Identify key audiences

Step 2—Determine desired "learner outcomes" for everyone

Step 3—Determine additional "learner outcomes" for each separate audience

Step 4—To achieve each "learner outcome" (all-audience and specific audience):
—Select strategies and tactics
—Identify materials available or needed
—Identify leadership roles, and human and financial resources available and/or needed
—Develop an evaluation program to measure changes in knowledge, attitudes, skills, and behavior

Step 5—Integrate strategies as a working draft for review

Step 6—Seek active support and initiate implementation

The basic elements suggested by the above process are outlined below. The plan is "audience-based," in part because educational leadership and in some cases, educational materials, are likely to be audience-specific. However, many of the techniques, methods, and materials used to educate one audience will be directly applicable to other audiences. Because of this, a key implementation recommendation for the overall strategy is the establishment of the Cascadia Earthquake-Tsunami Education Network. This network will help ensure maximum sharing of educational resources and information.

Audiences for Earthquake Education

Six key audiences for earthquake education were identified, recognizing that individuals will tend to fall into more than one category:

Audience 1: Residential, Workplace, and Gathering Place

Residential: parents, children, seniors, the physically-challenged, and other individuals who live in private homes, apartment buildings, group homes, and other places of residence.

Workplace: owners and employees of small and large service and information or technology-based businesses; workers and managers of factories and other light and heavy industrial facilities; individuals involved in farming, logging, fishing and other resource industries; etc.

Gathering Places: people involved in churches, community centers, senior centers, etc.

Audience 2: Schools and Youth

Preschool and K-12 school children, teachers, administrators, staff, board members, and parents, including building site councils; home schoolers and their parents; students, faculty, and staff at community and other colleges and universities; child care providers (baby sitters); participants in after-school programs such as sports, Little League, Scouts, YMCA, 4-H, church groups, specialty youth programs, hang-outs, community pools, recreation centers, gangs.

Audience 3: Government and Critical Service Providers

Local, state, and federal government elected and appointed officials and professionals who make and implement policy; emergency service managers and providers, including fire, police, medical emergency and hospital, Red Cross, transportation and public works, TV, media, Coast Guard, National Guard and other military; transportation facilities and workers (airports, ports, rail, highway, street); communicators, including the Emergency Broadcast System, television, paper media; public and private utilities, including gas, electric, water, sewer; home health deliverers; Salvation Army/churches; social services, including psychologists, counselors, etc.; food and drink outlets, including grocery stores and supermarkets; scientific and emergency response experts that can interpret events.

Audience 4: Visitors and Tourists

Visitors at hotels and motels, campgrounds, RV parks, and other temporary residential accommodations; second home owners; day visitors at parks and other public areas, including lakes, beaches, and rivers; bicyclists; business conference and pleasure tour groups; transporters (bus companies), foreign visitors with language barriers; travel agents, short course teachers and students; seasonal workers; vacationing youth or school groups; sponsors of attractions.

Audience 5: Developers, Contractors, Designers, Hazard Consultants

Property developers, architects, design and structural engineers, builders, and other construction contractors; geologists and engineering geologists; surveyors; land use planners and consultants.

Audience 6: Financial and Legal Sector

Real estate brokers, associates, appraisers; title insurance companies; attorneys; insurance agents and companies; bankers and other lenders; private home and building inspectors; asset and property managers.

Education Strategy Applicable to all Audiences

Learner Outcomes and Education Strategies and Tactics

Learner outcomes are the desired changes in knowledge, attitudes, skills, and behavior of the target audience of an educational program. They are usually expressed in terms that are specific, measurable, and subject to evaluation. What became clear in developing the overall strategy was that two learner objectives apply to nearly all audiences.

First, everyone needs to be aware of the frequency, type, magnitude, and destructiveness of potential earthquakes in Oregon—earthquake awareness.

Second, everyone should prepare for earthquakes including; knowing what to do when an earthquake strikes and developing a plan ahead of time, for survival after the quake—preparedness and response.

The specifics that apply to all audiences are detailed below. In subsequent discussions of education plans for each specific audience, other details applicable to that audience, as well as additional learner outcomes are found.

Learner Outcome 1: Earthquake Awareness

Everyone will be aware of and understand earthquake potential, risks, and vulnerability in the Cascadia region.

They will:

- understand what earthquakes are and what causes them;
- be aware of the kinds of earthquakes that could occur in the region, especially of the presence and significance of the CSZ;
- know what to expect during and after each type of earthquake;
- know what tsunamis and seiches are;
- understand and respect earthquake *hazards, risks, and vulnerability*; e.g., strong ground motion, liquefaction, landslides, slumping, lateral spreading, surface ruptures, subsidence, etc.;
- understand that they are likely to survive, but that the community might be severely affected, e.g., some loss of life, many injuries, isolation in small groups/areas, and damage to buildings, roads, bridges, dams, utilities, etc.;

Hazard means the probability of a given area being affected by potential disaster phenomenon within a given time frame;

Vulnerability means a measure of proportion of value likely to be lost (lives, property, etc., e.g., 10%);

Risk means the possibility of a loss within area subject to the hazard (Risk = value x vulnerability x hazard);

Learner Outcome 2: Preparation and Response

All agencies, organizations, institutions, and individuals will prepare in advance for an earthquake; they will have a written emergency *plan of action* for what they will do when an earthquake strikes. They will:

- know the appropriate action to take during and after an earthquake;
- examine their home, workplace, other gathering places, etc., for structural and non-structural hazards and will eliminate or minimize them;
- have earthquake emergency kits at home, the workplace, and automobile that will get them through at least 72 hours;
- know the community, business, family plans, the chain-of command in the community, and their own role;
- know where emergency and operation centers in the community will be located;
- know the value of emergency planning for saving lives and in enabling people/businesses/schools/etc. to return to normal more quickly after a disaster;

- know how to file plans with appropriate agencies.
- determine if they live or work in a tsunami inundation zone and, if so, develop an evacuation plan.
- know to what extent they are legally liable for preparing for earthquakes and for mitigating earthquake hazards in their school, business, hospital, etc.

Strategies/Tactics

1. Establish a Cascadia Earthquake-Tsunami Education Network of educators, public and private educational institutions and organizations, and other interested individuals; establish a coordinating office; seek grant funding to support this network. Such a network would be something like BAREPP (Bay Area Regional Earthquake Preparedness Project).
2. Identify, collect, catalog, disseminate, critique, and adapt existing earthquake education materials to Cascadia region; put a catalog together. Establish a single library.
3. Tailor materials to specific audiences, learning styles, educational levels, and geographic areas of Cascadia.
4. Develop a Cascadia-wide speakers bureau on earthquake hazards; a who's who of earthquake and preparedness experts.
5. Develop a model educational package w/ video, slide set w/text, fact sheets, etc. that could be adapted; plus a model workshop w/ expert panel on earthquakes, experiential earthquake, preparedness/response needs
7. Develop media packets that could be used when a earthquake happens. Include the following: general earthquake information, specialist contacts, tsunami warnings, etc. (check BAREPP for ideas) (see recent EERI article on what media needs to know)
8. Develop an earthquake awareness, preparedness, and response education fair (e.g., in Pioneer Square, Marine Science Center (South Beach Marina); also in association with other events
9. Develop master earthquake advisor program similar to master gardener program
10. Develop clear, simple educational materials on earthquake hazards that can be delivered through print media, radio, and television. Include examples of what might happen to roads, sewers, facilities, etc. that aren't adequately protected.

Educational Materials and Resources

Principal resources include publications and materials from:

- Earthquake Engineering Research Institute
- FEMA
- U.S. Geological Survey
- American Red Cross
- California Seismic Safety Commission
- Bay Area Regional Earthquake Preparedness Project (BAREPP)

Additional needs include:

- detailed information on the tsunami threat from a large earthquake
- videos or other materials that simply explain the threat of earthquakes in Oregon

Leadership/Human Resources

Technical: U.S. Geological Survey, FEMA, NOAA, CSZ Working Group, University faculty, state, provincial, and local emergency management, fire marshals and departments, police.

Education Design/Development: Cascadia Earthquake-Tsunami Education Network, U.S. Geological Survey, FEMA, state and provincial departments of geology and education, educational service districts curriculum development, offices of emergency management, police, and fire safety (state, provincial, county, city), Red Cross, universities, schools (K-12), extension services, community colleges.

Delivery: Cascadia Earthquake-Tsunami Education Network and associated local network, U.S. Geological Survey, FEMA, state and provincial departments of geology and education, offices of emergency

management, police, and fire safety (state, provincial, county, city), Red Cross, schools (K-12), universities, extension services, community colleges, public radio/TV, libraries, insurance companies, other disaster relief organizations.

Funding Resources

FEMA, U.S. Geological Survey, National Science Foundation, Land and Sea Grant institutions, professional societies, private foundations, federal and state departments of education, offices of emergency management and seismic safety, other federal, state, and local public and private sources.

Educational Strategies for Residential, Workplace, and Gathering Place Audiences

Learner Outcome 1: Earthquake Awareness (see overall learner outcomes for general strategies)

Learner Outcome 2: Preparation and Response (see overall learner outcomes for general strategies)

Strategies/Tactics

1. Identify and distribute earthquake awareness information through non-traditional sources (malls, department stores, etc.); have earthquake prep "scavenger hunt" in stores with your kids.
2. Make members of communities aware of the need to protect critical services (specific to government/critical service providers).
3. Have information included with power or other bills.

Other Learner Outcomes

1. Critical suppliers of food, fuel, etc, will understand the importance of having coordinated community and neighborhood plans to provide such materials and prevent looting.
2. Boat owners will have a specific plan for dealing with earthquake and tsunami hazards.
3. Factory owners and others dealing with hazardous materials will have materials stored in a way to prevent fires or explosions during a quake.

Strategies/Tactics

1. Families/Residences: Disseminate information through children (school), church, employment, media, utility bills, phone book, local awareness campaigns, neighborhood meetings, civic organizations, homeowner association meetings, celebrity endorsements, mobile demonstration van, etc.
2. Workplace: Stress the importance of a plan for returning to business after an earthquake, including how to determine a building is safe to reenter. Require an earthquake plan as a condition for obtaining a business permit or other licenses, for essential facilities and businesses with hazardous materials; have the Chamber of Commerce design and distribute planning guidelines, organize talks at business association meetings, etc.
3. Gathering Places: Require an earthquake plan as part of building and fire safety inspections; disseminate information through churches, councils, and other organizations.
4. Outline and distribute a checklist to help develop a plan and stock the 72 hour kit.
5. Tailor kits to number of persons in the living or work unit. Include information sources and a list of available materials.
6. Identify and distribute information through non-traditional sources (malls, department stores, etc.) on awareness, kits; have kits available; have earthquake prep "scavenger hunt" in stores with your children.
7. Work with professional organizations and publications on how to prepare for events; civic organizations; chambers of commerce.
8. Include earthquake preparedness as an element of performance appraisals for personnel with responsibilities for groups of people (schools, pre-schools, group homes).
9. Develop/adapt/disseminate info on model earthquake preparedness plans, and disaster kit.
10. Financial Incentives including: insurance rate discounts, tax incentives, available

low-cost items needed for kit (through retail store).

Education Strategies for Schools and Youth Audiences

Learner Outcome 1: Earthquake Awareness (see overall learner outcomes for general strategies)

Learner Outcome 2: Preparation and Response (see overall learner outcomes for general strategies)

Other Learner Outcomes

1. Child care providers and school administrators will know how to make an earthquake preparedness plan, which will include (at a minimum or in accordance with FEMA bulletin 88, see appendix):
2. Schools will send earthquake information to home schoolers.
3. All educational agencies will have earthquake preparedness and survival curriculum in place.
4. Staff and students will know whether they are in an area susceptible to tsunami inundation and know how to lead students to safety in the event of an earthquake.
5. Schools will send information to radio stations about how parents can retrieve their children after an earthquake.

Strategies/Tactics

1. Prepare earthquake curriculum specific to the Northwest.
2. Should involve common curriculum goals (integrated curriculum with science, math, social science) that can be cross referenced.
3. Have an outside person/agency come into school to talk (fire, police).
4. Tie into an "Earthquake Safety Week."
5. Use FEMA earthquake curriculum and make it simple for teachers to instruct.
6. Media blitz to announce materials (as done by U.S. Geological Survey in CA).
7. Require earthquake drills for all students (pre-schoolers to college), not ending at eighth grade
8. Distribute with fire safety skills curriculum.
9. Prepare a basic set of lessons that are the basic information students need to know in order to survive an earthquake, and then have additional supplementary lessons available for teachers interested in teaching more about earthquakes.
10. Develop a CD-Rom that includes all the earthquake curriculum available.
11. Workshops for teachers—free, sponsored by GSA.
12. Course ware for teachers to help meet learning outcome.
13. Lists of outside resource experts who can come into the schools.
14. Require all schools to file earthquake drill information with fire departments as they presently do with fire drills.

Education Strategies for Government and Critical Service Providers

Learner Outcome 1: Earthquake Awareness (see overall learner outcomes for general strategies)

Learner Outcome 2: Preparation and Response (see overall learner outcomes for general strategies)

Other Learner Outcomes

1. Government officials will understand the magnitude of impact a large earthquake will have on their community.
2. All legislators will know/learn the importance of continued support of earthquake education.
3. State and local government will know to evaluate vulnerability, hazard potential, and response capability.
4. Critical services will recognize that they may not be able to respond as well as planned.
5. Priority: Critical service providers will have personal/family plans in place that they have confidence in so they can concentrate on their job—they will know that the community emergency management system is in place and working.
6. Critical emergency workers (including utilities) will have confidence in their own

family plan so they can do their expected duties.

7. Government will have a plan for helping people with post-disaster response.
8. Lifelines staff will review interdependent relationships among lifelines (e.g. same conduit or tower).
9. Local emergency managers and the Red Cross will include likely scenarios for isolation due to bridge collapse etc. into their planning process.
10. Emergency workers will know how to deal with looting and panic.
11. Maintenance supervisors will know how to identify earthquake hazards at their work sites.
12. Government will have a plan in place to record the information on structural and other damage information after the quake.
13. All critical service provider groups will know how they will communicate with each other after an earthquake.
14. Governments will know the importance of post-disaster reconstruction planning, and will incorporate this into their earthquake planning process.

Strategies/Tactics

1. Ensure that critical individuals know who they are.
2. Put together a good information package for decision-makers to educate them on the need for a community emergency management plan, so resources and support are available.
3. Organize a "getting started" workshop series for all coastal jurisdictions with local and other experts.
4. Education program content:

- identify the magnitude of the problem
- personal experiences with earthquakes
- how to do a "plan"/system (steps, resources, follow-up)
- have a local earthquake/tsunami scenario

5. Require county, city, or community audit of emergency preparedness.
6. The governor's office will establish policies for agencies to prepare, coordinate, and respond to earthquakes.
7. Require all government and service agencies (including National Guard and Coast Guard) to have an earthquake preparedness component in their planning process.
8. Enforcement and emergency services will have an earthquake information and/or training program for employers of local businesses.

Resources

- CSZ technical group looking for a mission
- planning experts

Leaders

- FEMA (sell as "model program"), OEM, OSU, CSZ group

Education Strategies for Visitor and Tourist Audiences

Learner Outcome 1: Earthquake Awareness (see overall learner outcomes for general strategies)

Learner Outcome 2: Preparation and Response (see overall learner outcomes for general strategies)

Other Learner Outcomes

1. Tourists will look or ask for information.

Education Strategies/Tactics

1. Motels/Hotels/Parks/Campgrounds will provide information in every room and to every visitor about earthquake/tsunami hazards, and will include an evacuation plan.
2. Tourism sponsors will educate visitors to coastal hazards using their particular venue/contact link.
3. Low power radio will broadcast earthquake education information.

Education Strategies for Developers, Contractors, and Consultants Audience

Learner Outcome 1: Earthquake Awareness (see overall learner outcomes for general strategies)

Learner Outcome 2: Preparation and Response (see overall learner outcomes for general strategies)

Other Learner Outcomes

1. Developers and contractors will know the hazard potential and the structural requirements needed to mitigate the earthquake hazard.
2. Geotechnical specialists will know how to identify and assess earthquake and tsunami hazards.
3. Contractors, architects, engineers, etc. need to know how to build to code and be able to deal with specific site or use needs (continuing education).
4. Contractors, architects, engineers, etc. will continue to educate themselves about earthquake construction techniques for new structures and retrofitting (continuing education).
5. Engineers need to understand seismic hazards, design, construction, inspection.
6. Contractors, architects, engineers, etc. will understand how to rebuild after an earthquake; assess the damage, recycle building materials, etc.

Strategies/Tactics

1. Require as part of licensing procedure additional training in dealing with earthquake hazards.
2. Offer courses that result in special certification. (i.e., contractors with special certification in earthquake retrofitting or geologists with certification to identify earthquake problems).
3. Publish manuals, write articles in professional journal, create videos, etc, with information on earthquakes specific to each specialty.
4. Teach special short courses at professional meetings.
5. Require earthquake certification for completing certain type of jobs.

Education Strategies for Legal and Real Estate Audiences

Learner Outcome 1: Earthquake Awareness (see overall learner outcomes for general strategies)

Learner Outcome 2: Preparation and Response (see overall learner outcomes for general strategies)

Other Learner Outcomes

1. Bankers will know that they must have an earthquake plan that includes providing money (services) and keeping records in an alternate location that would not be affected by a large CSZ earthquake.
2. Insurers will be aware of the structural and site hazards before insuring property for earthquakes.
3. Lending institutions will reassess their lending practices and standards in light of our new knowledge of seismic risk.
4. Lenders, title companies, etc. will inquire about the hazard status of each property in question.
5. Buyers will have seismic hazards disclosed to them.
6. Realtors/sellers will be required to disclose coastal hazards information.

Strategies/Tactics

1. Special classes for lenders/insurers
2. Video, articles, etc. that are aimed at lenders/insurers